

Appendix C

Economics

Fargo-Moorhead Metropolitan Area Flood Risk Management

Final Feasibility Report and Environmental Impact Statement

July 2011



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of Engineers®**

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Appendix C

Economics Appendix

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- 1- Fargo-Moorhead Nonresidential and Residential Structure Inventory and Surveys
- 2- Transportation Analysis

List of Acronyms and Abbreviations

AAD	Average Annual Damage
ACS	American Community Survey
AEP	Annual Exceedance Probability
BEA	Bureau of Economic Analysis
CES	Current Employment Statistic
cfs	Cubic feet per second
CGE	Computable General Equilibrium
CNP	Conditional Non-exceedance Probability
DDF	Depth-Damage Function
EAB	Expected Annual Benefit
EAD	Expected Annual Damage
EEAB	Equivalent Expected Annual Benefit
EEAD	Equivalent Expected Annual Damage
FCP	Federally Comparable Plan
FEMA	Federal Emergency Management Agency
FFE	Finished Floor Elevation
FTE	Full-Time Employee
GFMEDC	Greater Fargo Moorhead Economic Development Corporation
GDP	Gross Domestic Product
I-O	Input-Output
kcf	kilo cubic feet per second
LPP	Locally Preferred Plan
LPT3	Log-Pearson Type III (analytical flow-frequency curve)
MSA	Metropolitan Statistical Area
NED	National Economic Development
P&G	Principles and Guidelines
RED	Regional Economic Development
USACE	United States Army Corps of Engineers
\$/sf	Dollar per square foot

1.0 Introduction

This appendix documents the National Economic Development and Regional Economic Development analyses conducted for the Fargo-Moorhead Metro Area Feasibility Study. The analysis follows the framework and methodology as directed by the Corps' Planning Guidance Notebook (ER 1105-2-100) dated 22 April 2000 and any updated guidance since then.

Alternative plans evaluated for flood risk management include diversions, levees/floodwalls, and nonstructural measures. These alternatives and others are discussed in detail in Appendix O of the main report.

An interest rate of 4-1/8 percent is used for discounting and present value calculations, except where otherwise noted. Costs and benefits are expressed in October 2011 price levels, except where otherwise noted. A 50-year planning period is assumed starting in the base year of 2019.

This analysis incorporates risk and uncertainty as directed by ER 1105-2-101, Risk-Based Analysis for Evaluation of Hydrology/Hydraulics, Geotechnical Stability, and Economics in Flood Damage Reduction Studies (1 March 1996) and EM 1110-2-1619, Risk-Based Analysis for Flood Damage Reduction Studies (August 1996). Uncertainty is inherent in all economic related input variables used in a typical flood damage analysis whether they may be LiDAR-originated ground elevations; first floor elevations determined by "windshield survey"; valuation of structures; generic depth-damage functions; content values based on content-structure value ratios; or assignment of occupancy type to structures for purposes of depth-damage calculations. Key hydrologic and hydraulic inputs such as frequency-discharge and stage-discharge relationships also possess their own elements of uncertainty. Attempts are made to address uncertainty by characterizing input variables in probabilistic terms rather than deterministic terms. Input data will typically be expressed as mean or median values with ranges determined by associated measures of variability.

In the context of planning for a flood risk management project, risk is typically associated with the residual threat of flooding and consists not only of the probability of its occurrence but also the consequences which can be expressed in both economic terms (i.e. flood damage) and in terms of public safety (threat of injury or loss of life). There is risk associated with the future without-project condition and the potential for flood-fight failure including related consequences. And there is risk associated with any with-project condition such as the potential for levees being overtopped or diversion capacities being exceeded, again all with related consequences. In addition to benefit-cost ratios and identification of a NED plan, results of this analysis will include descriptions of the residual risk associated with the various alternatives.

The Other Social Effects Account is considered in Appendix D.

2.0 Background

The Fargo-Moorhead Metropolitan area has a relatively high risk of flooding. The highest river stages have usually occurred as a result of spring snowmelt, but summer rainfall events have also led to significant flood damages. The Red River of the North (Red River or RNN) has exceeded

the National Weather Service flood stage of 18 feet in 48 of the last 109 years, and every year from 1993 through 2011. The residents of Fargo-Moorhead have been successful at preventing significant damages during past flood events by constructing emergency levees along large portions of the Red River. Constructing the emergency levees takes significant financial and human resources, causes business and traffic disruptions, and is taxing to the social fabric of the communities. Although the emergency levees have been successful in the past, there is a high risk of a catastrophic failure which would result in significant damages to the area. Because of the flood risk, permanent measures are being evaluated to reduce potential flood damages.

A number of flood risk management alternatives have been considered as part of the Fargo Moorhead study. The alternatives were evaluated and screened based on the 4 accounts (National Economic Development, Regional Economic Development, Other Social Effects, and Environmental Quality) as well as other screening criteria discussed in Appendix O.

River levels of the RRN are often expressed in terms of stage above the zero elevation datum at the USGS gage in Fargo. The gage, located near river mile 453.0, has a zero datum elevation of 862.74 (1988 North American Vertical Datum). A river elevation of 897.74 at the gage, therefore, would be referred to as a stage of 35 feet (i.e., 897.74 minus 862.74). This allows for a common point of flood elevation reference throughout the local area.

2.1 Study Area

The geographic scope of the economic analysis encompasses the Fargo-Moorhead Metropolitan region, located within the area from approximately 12 miles west to 5 miles east of the Red River and from approximately 300 river miles north of Fargo near Emerson Manitoba to approximately 30 miles South of Fargo near Abercrombie ND. This area includes the Red River and the downstream portions of the Buffalo River, Wild Rice River (North Dakota), Sheyenne River, Maple River, Rush River, and other contributing streams that enter the Red River in the study area (Figure C-1). In North Dakota the study area includes a portion of Cass County and the cities of Fargo, West Fargo, Hickson, Oxbow, Wild Rice, Frontier, Briarwood, Prairie Rose, Horace, Reiles Acres, and Harwood. In Minnesota the study area includes a portion of Clay County and the cities of Moorhead, Dilworth, Oakport, Rustad, Kragens and Georgetown.

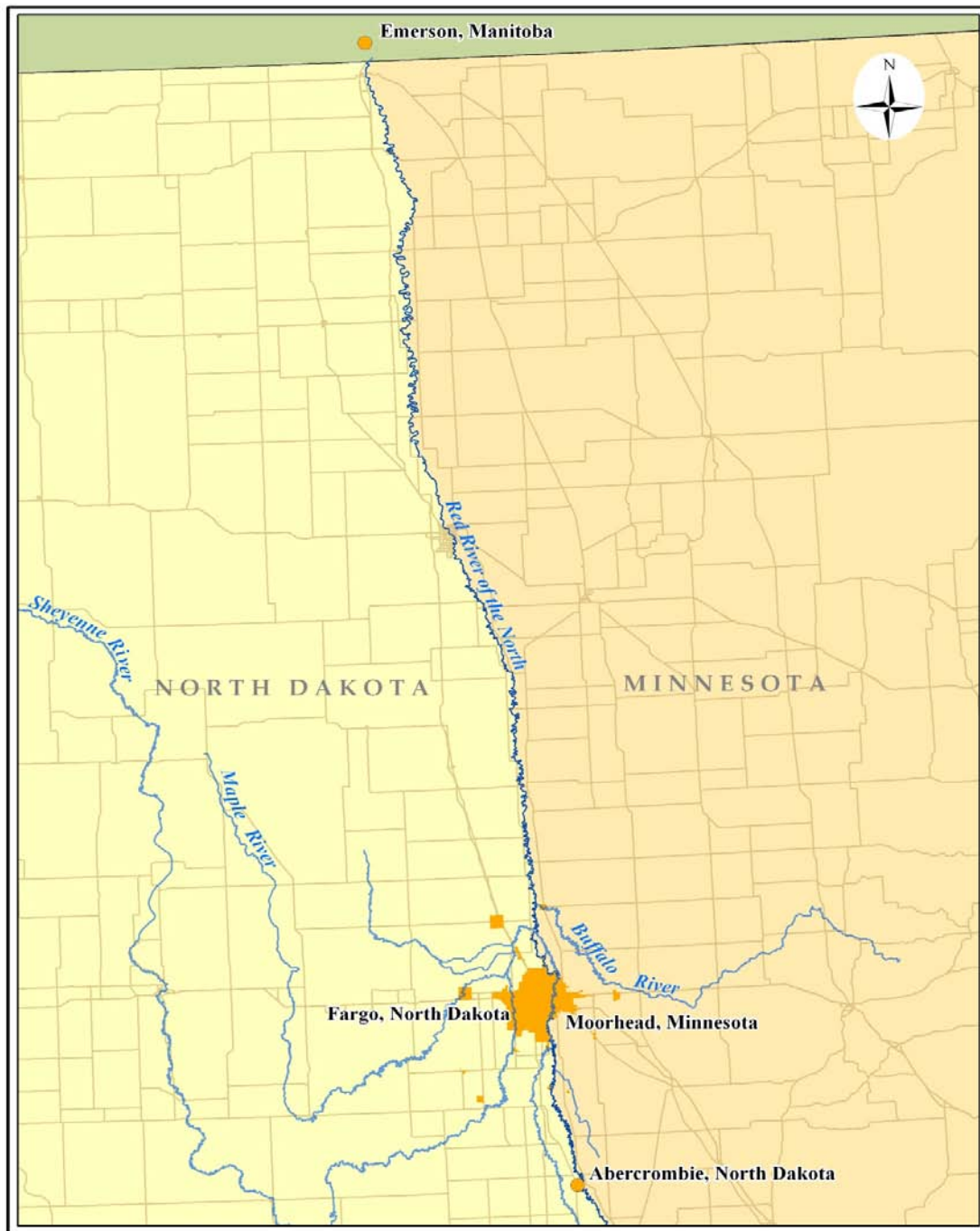


Figure C-1: Study Area

2.2 Fargo-Moorhead Regional Economy

The Fargo-Moorhead Metropolitan Statistical Area (MSA) straddles the North Dakota and Minnesota border on either side of the Red River. Fargo-Moorhead's business environment continues to grow and is ranked as follows, according to the Greater Fargo-Moorhead Economic Development Corporation (GFMEDC) Web site (2009):

- *#5 in Forbes ranking of the Top College Towns for Jobs in May 2009.*
- *#7 in Forbes Best Places for Business and Careers in March 2009. This is the sixth consecutive year that Fargo has made the top ten for small metropolitan areas. The index ranks cities according to cost of doing business, educational attainment of the population, income growth, projected job growth and net migration.*
- *#1 city in North Dakota for entrepreneurial start ups, according to Business Week.*
- *#8 in MSN and CareerBuilder.com's October 2008 list of the 25 Best Markets to Find a Job.*

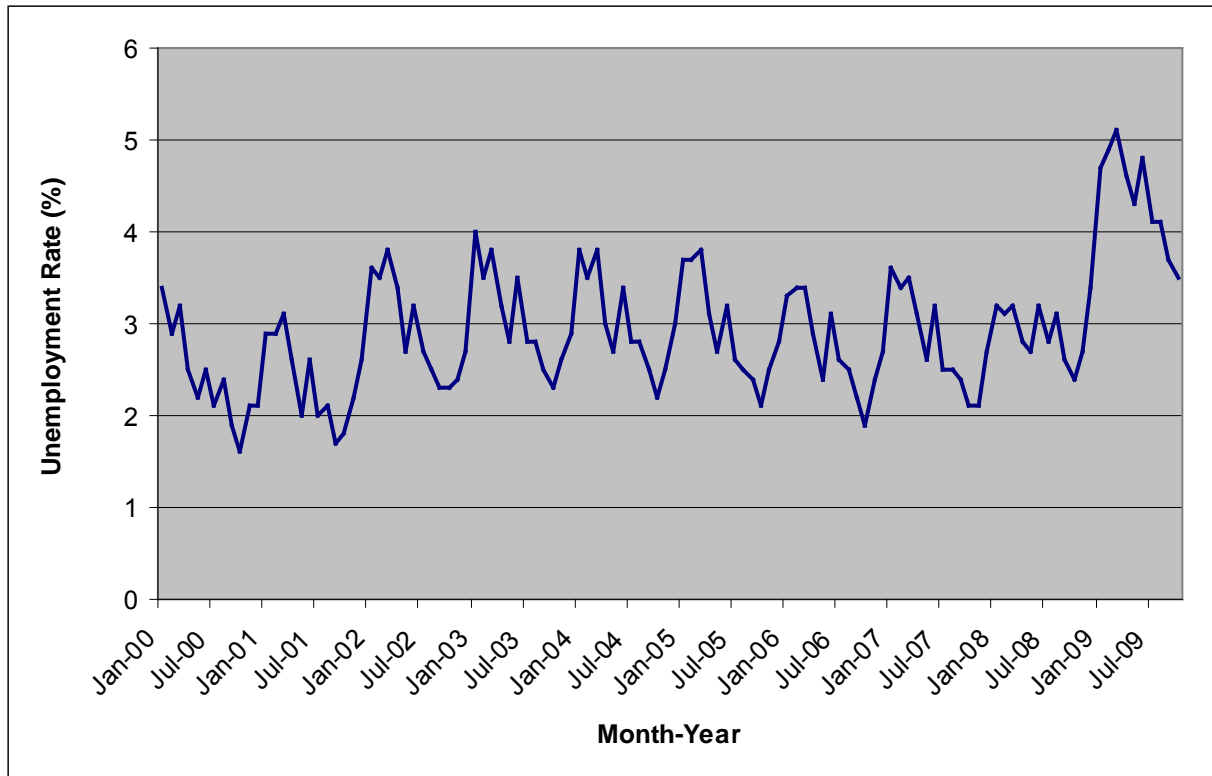
With one of the lowest unemployment rates in the nation, Fargo-Moorhead has consistently experienced gains in income and employment that exceed the national average. Data for the years 2004 through 2008 are shown in Table C-1. According to Moody's Economy.com, the Fargo-Moorhead economy continues to rank among the highest in vitality for U.S. metropolitan areas (GFMEDC 2009).

Table C-1 Fargo-Moorhead Economic Indicators

	2004	2005	2006	2007	2008
Gross Metro Product (\$ billions)	6.7	7	7.2	7.6	8.1
Change over previous year (%)	3.5	4.8	2.1	5.8	6.4
Total Employment	109,600	112,700	115,600	118,700	121,800
Change over previous year (%)	3	2.8	2.6	2.7	2.6
Unemployment Rate	3	3	2.7	2.8	2.9
Personal Income Growth	6.5	6.1	6.5	7.3	9.5

Source: Moody's Economy.com, Oct. 2009 as cited in GFMEDC (2009)

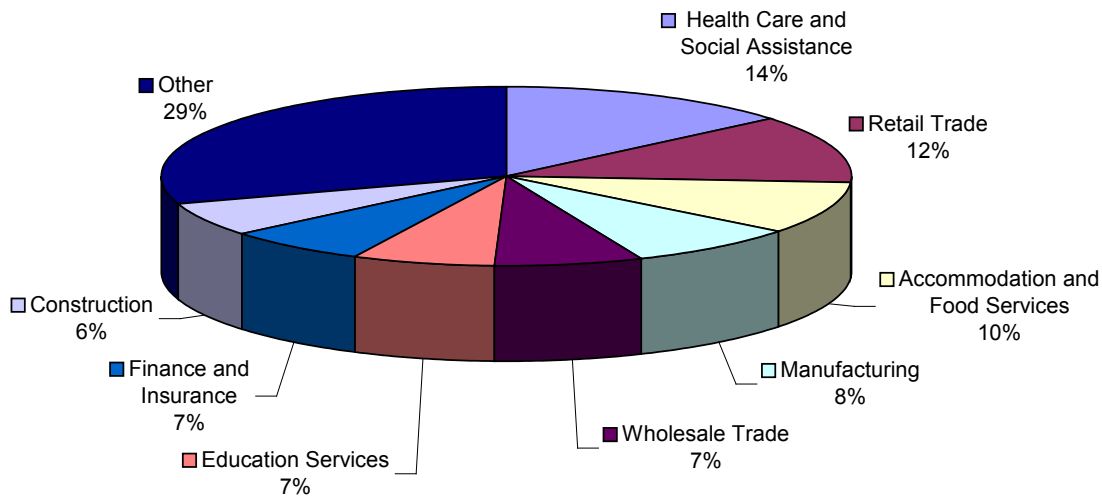
The Fargo-Moorhead metro area has one of the lowest unemployment rates in the Nation. In October 2009, the unemployment rate in the metro area was 3.7, and the national unemployment average during March 2009 was 8.6 percent (U.S. Bureau of Labor and Statistics, 2009). As recently as December 2010, the State unemployment average in North Dakota was 3.8 percent and in Minnesota it was 6.9 percent, compared to the national average of 9.4 percent (U.S. Bureau of Labor and Statistics, 2010). Figure C-2 displays unemployment trends for the Fargo-Moorhead MSA from the years 2000 to 2009.



Source: Job Service North Dakota, Labor Market Information Center, LAUS Unit, Jan. 2010

Figure C-2: Monthly Unemployment Data for Fargo-Moorhead MSA

Historically, the economy in Fargo-Moorhead has been dependent upon agriculture; however, that has changed substantially in recent decades. Now, the economy is based on retail trade, healthcare, technology, higher education and manufacturing. Major employers in the Fargo-Moorhead MSA are in the healthcare and education industries. Among the companies with the largest number of full-time employees (FTEs), the top five are in one of these two industries. MeritCare Health Systems is the largest employer with 3,691 FTEs (GFMEDC 2010). North Dakota State University is the second-largest with 2,401 FTEs. Notable mentions in other industries, such as back office operations, are the US Bank Service Center with 952 FTEs, and in the technology industry, Microsoft with 948 FTEs. Figure C-3 shows the percentage employed by each major industry.



Source: Greater Fargo Moorhead Economic Development Corporation (January 2010)

Figure C-3: Percentage Employed by Major Industry in Fargo-Moorhead MSA (2nd quarter 2009)

2.3 Population Size and Composition

According to the 2008 ACS, the population of the Fargo-Moorhead metropolitan area is estimated to be 194,839 persons. Based on the 2000 census, the total population in the 12-county study area is estimated to be 349,314 persons. In the metro area, the gender ratio is 1 to 1 (50 percent male and 50 percent female) and the median age is 31.6 years. Nationally, the population is 51 percent female and the median age is 36.7 years. Persons under 18 years old represent 23 percent of the population, which is lower than the national percentage of 25 percent. The percentage of residents over the age of 65 years (10 percent) is also lower in the metro area than the national percentage of 13 percent. The communities downstream of the metro area have lower percentages of persons under 5 years old, but higher concentrations of persons over 65 years old. It can generally be said of the downstream communities that, on average, they have a slightly higher percentage of older persons than is found in the metro area.

With the exception of Clay County, MN, and Grand Forks and Cass Counties, ND, the counties in the study area experienced a decline in population between 2000 and 2009. The decreases ranged from as little as 1.9 percent to as much as 17.1 percent. Over the past 50 years, the communities downstream of the Fargo-Moorhead metro area have seen population losses between 10 and 35 percent. The population of nearly every city and township between Fargo-Moorhead and Thompson, ND has decreased, with the exception of Oakport and Kragens Townships, which are located immediately downstream of the metro area.

2.4 Income and Poverty

The median household income of the Fargo-Moorhead metropolitan area was somewhat lower (\$47,636) than for the United States as a whole (\$52,175). The poverty rate of individuals (12 percent) mirrored closely the national rate (13 percent). However, the child poverty rate was lower than the national rate: 11 percent of children less than 18 years of age lived in poverty in the Fargo-Moorhead metropolitan area, compared to 18 percent nationally. The poverty rate among families (7 percent) was slightly lower than the national rate of 10 percent; the poverty rate among female-headed households (31 percent) was very close to the national rate (29 percent of families that had a female-headed household and no husband present). Whereas 27 percent of households received Social Security nationally, 20 percent of Fargo-Moorhead metropolitan area households did.

2.5 Journey to Work

For commutes to work in Fargo-Moorhead metropolitan area, the proportion of workers who drove alone was somewhat higher than in the United States as a whole (82 percent versus 76 percent nationally), and the proportion who carpooled (9 percent) or used public transportation (1 percent) were somewhat lower. Notably, an estimated 7.1 percent of occupied households had no vehicle available (ACS pooled data from 2006–2008).

The mean travel time to work in all 12 counties in the study area was less than 25 minutes and, with the exception of Marshall and Norman Counties, MN, commute times were less than 20 minutes (U.S. Census Bureau, 2000).

2.6 Previous Flood Events

Local communities overwhelmingly believe there is a need for a flood risk management project.¹ The Red River has exceeded the 18 foot flood stage in 48 of the past 109 years and every year from 1993 through 2011. During each of these years, the cities constructed emergency levees to some extent to hold flood waters back and prevent damages. In recent history, the two flooding events that have had the greatest physical and emotional effect on the communities of Fargo and Moorhead are the 1997 and 2009 flood fights.

2.6.1 2009 Flood Event

The Red River flood of 2009, which affected large parts of both North Dakota and Minnesota, brought record flood levels to the Fargo-Moorhead area. At one point, the Red River was predicted to reach a level near 43 feet at Fargo. It actually crested at 40.82 feet at 12:15 a.m. on March 28, 2009. A severe cold snap on March 31 prevented an expected second crest, slowing the anticipated snow melt and allowing the river to retreat. Without the storm, many believed the flood walls and flood levees in and around Fargo and Moorhead would have been overtopped, which would have led to catastrophic damages within both cities.

The President declared a major disaster for most of the State of North Dakota on March 24, 2009 (FEMA 2009a). In addition, an emergency declaration was made for counties in the northwest of

¹ In 2009, 90% of Fargo residents voted in favor of a 1% increase in sales tax to contribute to the cost of permanent flood control (pers. comm. Brian Walters CEO GFMEDC).

Minnesota that directly border North Dakota and the Red River. The major disaster and emergency declarations enabled the Federal Emergency Management Agency (FEMA) and other Federal agencies to make Federal funding available to State and eligible local governments, and certain private nonprofits, for response and recovery.

The Mayor of Fargo requested that all businesses not critical to the flood fight remain closed for a week starting on March 25, 2009 to ensure the transport route was kept clear for trucks carrying essential sand for sandbags. The closing of businesses made greater human resources available to assist in the flood fight by filling sandbags and building levees to reduce damages to the city. In addition, local universities were closed for 2 weeks to allow students to help with the flood fight.

Characteristics of the 2009 flood fight in the Fargo-Moorhead area include:

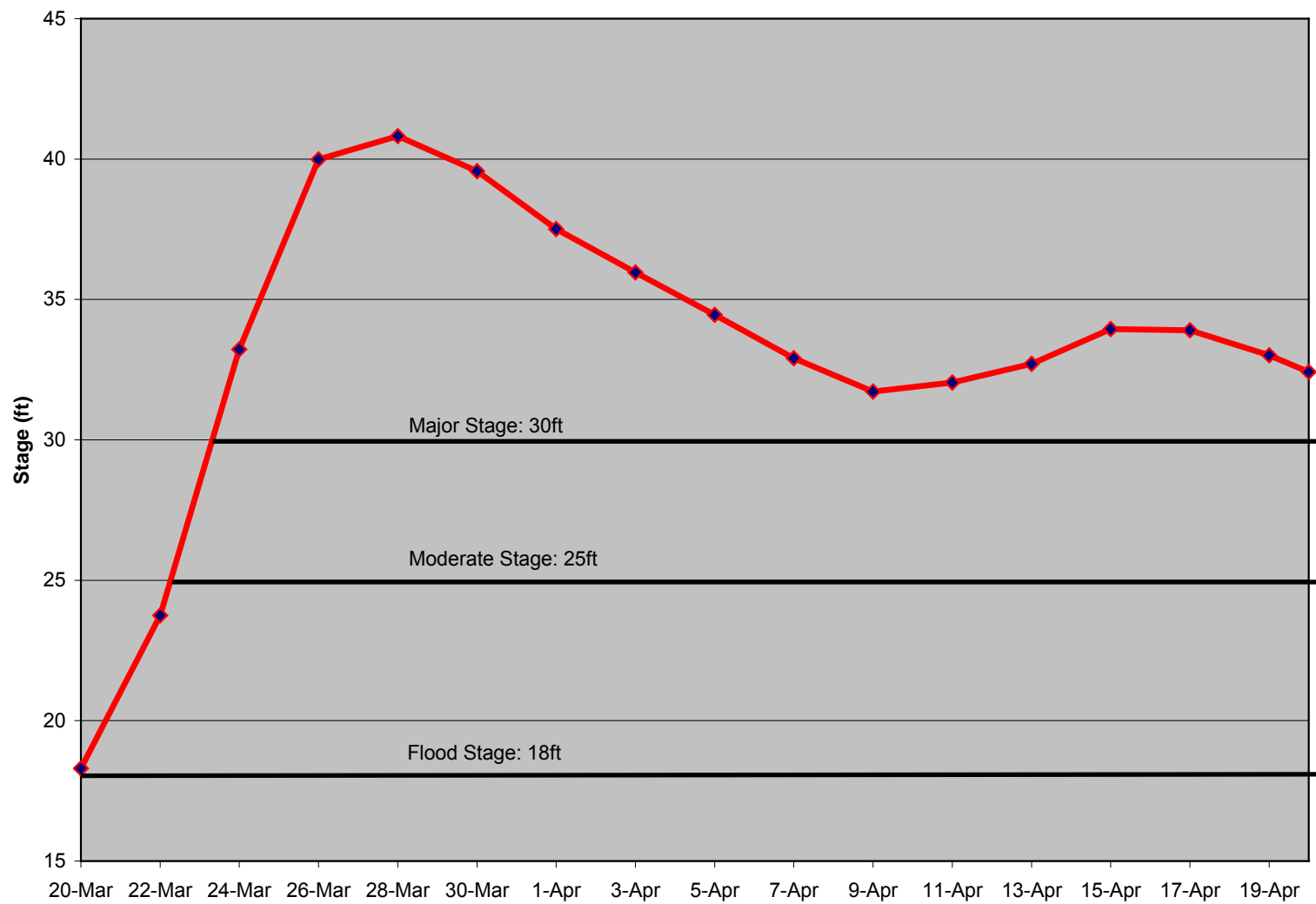
- Flood crested at 40.82 feet (refer to Figure C-4)
- Approximately 3.5 million sandbags were filled and placed (Walaker 2009)
- 100,000 people volunteered to assist with the flood fight (Forum of Fargo-Moorhead 2009)
- Over \$150 million in disaster aid for North Dakota (2009 dollars; FEMA 2009b)
- Non-critical businesses were requested to remain closed for the week from March 25 to April 2 (Refer to Figure C-5)

2.6.2 1997 Flood Event

The Red River Flood of 1997 was a major flood that occurred in April and May 1997, along the Red River in North Dakota, Minnesota and southern Manitoba. Flooding was experienced throughout the Red River Valley, affecting the cities of Fargo and Winnipeg, but the greatest impacts were felt in Grand Forks and East Grand Forks, where floodwaters spread over 3 miles (5 kilometers) inland, inundating the twin communities.

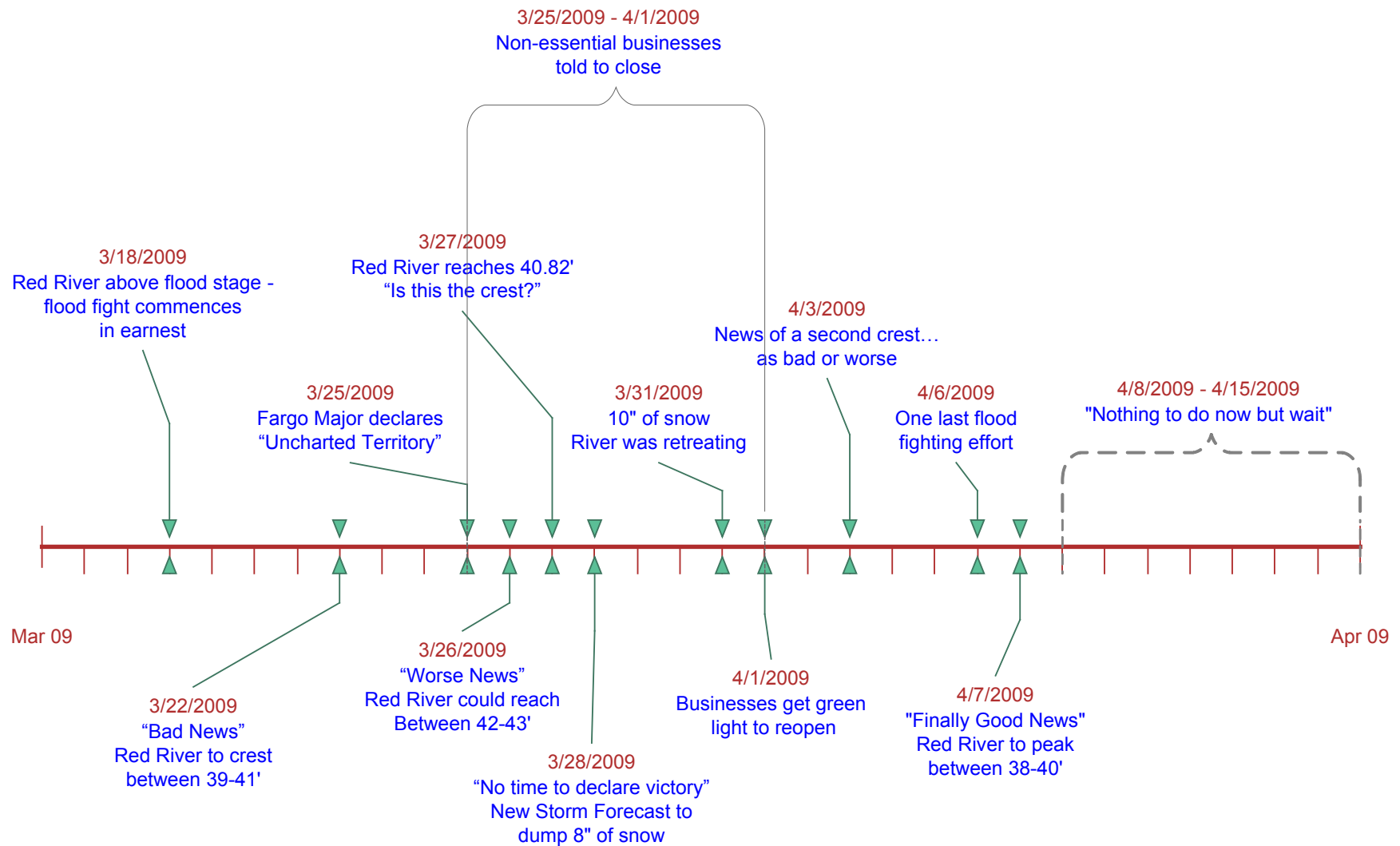
Characteristics of the 1997 flood fight in the Fargo-Moorhead area include:

- Flood crest at 39.64 feet
- Total damages for the Red River region were \$3.5 billion (1997 dollars; Shelby 2004)
- 3 million sandbags were filled and placed (Walaker 2009)
- Major flood impacts were in Grand Forks and East Grand Forks



Source: *The Forum of Fargo-Moorhead* (2009)

Figure C-4: The Red River at Fargo-Moorhead 2009



Source: Developed from the Forum of Fargo-Moorhead (2009)

Figure C-5: 2009 Flood Timeline

3.0 National Economic Development Account

3.1 Analysis Goals, Framework, and Terminology

3.1.1 Goals

A number of flood risk management measures were considered to address the flooding problem in the study area. These measures and combinations thereof were developed into alternative plans. Each plan was evaluated on the basis of National Economic Development (NED) benefits and NED costs. This account identifies the net benefits and benefit-cost ratio of each plan considered. The plan with the highest net benefits (NED benefits minus NED costs) is identified as the NED plan.

Two additional goals of this analysis are to identify the without-project equivalent expected annual damage (section 3.7) and project performance for each alternative (section 3.9).

3.1.2 Framework

Benefits and costs are determined using the “with project” versus “without project” framework. With- and without project conditions are forecasted based on an inventory of existing conditions that include hydrologic, hydraulic and economic conditions for the entire study area. Special consideration is given to foreseeable hydrologic, hydraulic and economic changes (with- and without-project) over the period of analysis.

The base year for this study is 2019. The base year is the point in time at which all benefits and costs are compared. All benefits and costs incurred prior to the base year are compounded to present worth. All benefits and costs incurred after the base year are discounted to present worth. The present worth of each benefit and cost stream is then converted into annual equivalent terms. The annual equivalents of each benefit and cost stream serves as the basis for comparing each alternative and identifying the federal plan. The current discount rate (4-1/8%) is used in discounting, compounding and annual equivalence, except where otherwise noted, as determined by EGM, 11-01, ‘Federal Interest Rates for Corps of Engineers Projects for Fiscal Year 2011.’

Benefits and costs were evaluated with uncertainty in each hydrologic, hydraulic and economic variable. Where appropriate, flood risk management benefits were evaluated using a certified program (HEC-FDA 1.2.4) intended for such use.

3.1.3 Terminology

Average Annual Damage (AAD) and Benefit (AAB)

When evaluating flood damages, it is useful to relate the amount of damage to the water surface elevation in the river. In turn, each water surface elevation is related to certain amount flow, and

each flow is related to a frequency probability of exceedance. Therefore, each level of damage can be associated with a frequency, resulting in a damage-frequency curve. Average annual damage (AAD) is defined as the area under the damage-frequency curve.

Typically, AAD does not incorporate uncertainty in flows, water surface elevations, or damages, however the term is often confused with expected annual damages. For the purposes of this report, AAD will represent the deterministic area under the damage-frequency curve (with no uncertainty).

AAD represents the average amount of damage that would occur in **any given year**, if **that year** were repeated infinitely many times over. The average value is based on the frequency of recurrence for each flood event. No other probabilistic variables are factored into the calculation of AAD.

AAD can vary by year, depending on changes in hydraulic, hydrologic, and economic conditions.

Average annual benefit (AAB) for any alternative is the difference between AAD without the alternative in place and AAD with the alternative in place.

Expected Annual Damage (EAD) and Benefit (EAB)

Expected annual damage (EAD) takes into account uncertainties in stage-damage, stage-flow, and flow-frequency relationships. EAD is the mean value of AAD, given the uncertainty associated with each damage, stage, and flow relationship. AAD and EAD are often confused, due to the similarity in the terms “average” and “expected.” For the purposes of this report, expected annual damages refers to the probabilistic definition offered above. EAD is computed using HEC-FDA version 1.2.4, which utilizes the Monte Carlo method for evaluating mean values.

Expected annual damage represents the mean amount of damage that would occur in **any given year**, if **that year** were repeated infinitely many times over. The mean value is based on the frequency of recurrence for each flood event, as well as the uncertainties in stage-damage, stage-flow, and flow-frequency relationships.

EAD can vary by year, depending on changes in hydraulic, hydrologic, and economic conditions.

Expected annual benefit (EAB) for any alternative is the difference between EAD without the alternative in place and EAD with the alternative in place.

Equivalent Expected Annual Damage (EEAD) and Benefit (EEAB)

Throughout the period of analysis, EAD can vary if there are changes in hydraulic, hydrologic, or economic conditions. If each year is taken in sequence from the beginning of the period of analysis to the end, the result is a series or “stream” of EAD values. Equivalent Expected Annual Damage (EEAD) is the equivalent annual value of the EAD stream. It is computed by

amortizing the net present value of the EAD stream. Equivalent values are not necessarily probabilistic values, and depend only on the discount rate, the number of years in the period of analysis, and the stream of values. The only uncertainties accounted for in EEAD are those already accounted for in EAD.

EEAD values do not vary by year, and serve as a means of comparing benefits and costs in a consistent manner. Equivalent Expected annual benefit (EEAB) for any alternative is the difference between EEAD without the alternative in place and EEAD with the alternative in place. The EEAB represents the benefit that the alternative yields each year. Based on time value of money, the EEAB value is “equivalent” to the benefit stream yielded by the project. From an investment perspective, someone earning an annuity equal to the EEAB value for the life of the project would be no better and no worse off if he or she earned the benefit stream instead.

3.2 Alternatives

Alternatives formulation has been performed in an iterative process through four phases of the study. A number of flood risk management measures were considered throughout the study. These measures are discussed in Appendix O of the main report. Results from Phases one and two are presented in Appendix O but not in this Appendix. The following alternatives were carried forward for detailed modeling of economic benefits as part of Phases III and IV.

3.2.1 No action

The no action alternative would entail that no federal action take place.

3.2.2 Diversion Alternatives

Diversions on the North Dakota and Minnesota side were carried forward for evaluation. A number of sizes were considered ranging from 10,000 cfs to 45,000 cfs capacity channels.

3.2.3 Non-Structural Alternatives

Non-structural measures are discussed and evaluated in Appendix P of the Main Report. The non-structural measures carried forward are incremental, meaning they would be considered in addition to diversions. The non-structural analysis found feasible non-structural measures with Minnesota diversions. There were no feasible non-structural measures with North Dakota diversions.

3.2.4 Recreation Alternatives

Each diversion alternative creates opportunities to develop recreation features. Recreation plans are formulated and evaluated in Appendix M of the Main Report. The recreation features carried forward are incremental, meaning they would be considered in addition to diversions.

3.2.5 Final Array of Alternatives

The following is a list of the final alternatives evaluated for NED benefits.

- Minnesota Short Alignment 10,000 cfs (Phase II)
- Minnesota Short Alignment 15,000 cfs (Phase II)
- Minnesota Short Alignment 20,000 cfs (Phase III)
- Minnesota Short Alignment 25,000 cfs (Phase III)
- Minnesota Short Alignment 30,000 cfs (Phase III)
- Minnesota Short Alignment 35,000 cfs (Phase III and IV)
- Minnesota Short Alignment 40,000 cfs (Phase III)
- Minnesota Short Alignment 45,000 cfs (Phase III)
- North Dakota East Alignment 35,000 cfs (Phase III and IV)
- North Dakota East Alignment 20,000 cfs with Upstream Staging (Phase IV)
- Non-Structural Alternatives (as increment)
- Recreation Alternatives (as increment)

Three of these plans were carried forward to Phase IV. The selection of these plans is discussed in Chapter 3 of the Main Report. These plans are discussed below. Exhibit J contains maps of these plans. The other diversions from Phase III generally follow the same alignments.

North Dakota East Alignment 35,000 cfs (ND35K)

The ND35K would divert floodwaters through North Dakota along a 36-mile-long diversion channel. The diversion channel would start approximately 4 miles south (upstream) of the confluence of the Red and Wild Rice Rivers and extend west and north around the cities of Horace, Fargo, West Fargo, and Harwood, ND. The diversion capacity for this alternative is 35,000 cubic feet per second (cfs). The ND35K induces downstream stage increases greater than 2-feet in some areas during certain flood events.

North Dakota East Alignment 20,000 cfs with Upstream Staging (ND w/Staging, also LPP - Locally Preferred Plan)

The LPP would follow the same alignment as the ND35K. The diversion capacity for this alternative is approximately 20,000 cfs. A storage cell would be placed at the southern end of the project area. The control structure at the inlet and the tie-back levees would be designed to stage water upstream and in the storage cell. The LPP would increase stages upstream by more than 8-feet for a 1-percent chance event. The LPP would require buying out and relocating between 800 and 1,200 structures upstream, between 200 and 400 of which are households.

Minnesota Short Alignment 35,000 cfs (MN35K, also FCP - Federally Comparable Plan)

The FCP would divert floodwaters through Minnesota along a 25-mile-long diversion channel. The diversion channel would start at the confluence of the Red and Wild Rice Rivers and extend east and north, ending near the confluence of the Red and Sheyenne Rivers. The diversion capacity for this alternative is 35,000 cubic feet per second. The FCP induces downstream stage increases greater than 1-foot in some areas during certain flood events.

Reach Delineation

Table C-2 describes the how the study area is divided in general along the Red River. Exhibit I includes maps with the layout of each damage reach and their configuration in HEC-FDA 2.4.1.

Table C-2 Study Area Delineation by River Mile

Metro - Downstream - Upstream		
Sub-Area	Dnstrm River Mile	Upstrm River Mile
Downstream from Metro to Thompson	316	433
Fargo-Moorhead Metro	433	478
Upstream from Metro to Abercrombie	478	525

3.3 Period of Analysis

The period of analysis for this study is 50 years (per ER 1105-2-100). The base year of the period of analysis is the first year that benefits accrue from any of the alternatives considered. The Minnesota diversion alternatives are expected to be completed in 2019, earlier than other alternatives. All benefits and costs are compounded or discounted to the base year. Existing conditions serve as the basis for determining conditions in future years. When referring to existing conditions, the conditions at the present time are intended. Future conditions can refer to any year or series of years in the future. Future without-project conditions are the conditions that would occur if no federal action were taken. Future with-project conditions refer to conditions that would occur if any number of the alternatives considered were implemented.

The analysis years for evaluation of EAD and EEAD are 2019 (base year), 2044, and 2069. Existing hydrologic conditions were identified and it was determined that the flow-frequency curve is likely to shift throughout the period of analysis. The years 2044 and 2069 were chosen to evaluate changes in hydrologic conditions (the HEC-FDA models have analysis years one year prior to those stated above, however this does not change the equivalent values).

Costs of alternatives can be accrued as early as 8.5 years prior to the base year. All costs prior to base year are compounded appropriately.

3.4 Existing and Future Hydrologic and Hydraulic Conditions

3.4.1 Flow-Frequency Curves

The Corps Hydraulic Engineering Center (HEC) recommended the use of discharge-frequency in analyzing flood risk in the Fargo-Moorhead study area. This approach yields more accurate

representation of uncertainties, particularly for the extreme infrequent events. This approach was utilized in the economic analysis for the Red River of the North (RRN) within the metro area.

RRN discharges were determined using the Log Pearson's III analytical approach. Statistics include a mean (M), standard deviation (S), skew (G) and an equivalent record length. These statistics define the flow- frequency relationship for the economic analysis (statistics vary by analysis year), as well as the uncertainty about the flow-frequency curve. The diversion alternatives will not impact the frequency curve. Therefore, the frequency curve statistics are the same for both with- and without-project conditions (though varying by analysis year)

3.4.2 Transform-Flow Curves

For existing and future without project conditions, a transform-flow relationship was used to convert unregulated flows to regulated flows to account for upstream storage in the floodplain, and at Orwell and Lake Traverse Dams. Table C-3 displays the transform-flow relationship for existing conditions at the Fargo gage.

Any of the diversion alternatives considered primarily impact discharges in the main river channel by diverting high flows around the metro area. For the RRN, the changes in discharges are modeled by adjusting outflows in the transform-flow relationship downward. Transform-flow relationships were analyzed for each analysis year and each diversion alternative. The transform-flow relationships serve as the basis for computing diversion flood risk management benefits in each analysis year.

Table C-3 Transform-Flow Relationship

Unregulated to Regulated		
Exceedance	Inflow	Outflow
<u>Probability</u>	<u>Discharge</u>	<u>Discharge</u>
0.99	554	440
0.9	1,814	1,450
0.75	3,428	2,800
0.5	6,655	5,600
0.2	14,322	12,150
0.1	20,808	17,000
0.05	27,960	22,000
0.02	38,445	29,300
0.01	47,153	34,700
0.005	56,524	46,200
0.002	69,914	61,700
0.001	80,791	74,000
0.0005	92,299	86,000
0.0001	120,572	120,572

3.4.3 Stage-Flow Curves and Water Surface Profiles

Two hydraulic models were used for economic analysis (see appendix B for more information). A steady flow model was developed in Phase II and III and used in the economic analysis for the RRN in the metro area. An unsteady flow model was developed in Phase III and IV and used in the economic analysis for tributaries and the RRN outside the metro area. Both models use Phase III hydrology with the “wet” period flows. These flows were developed at the recommendation of the Expert Opinion Elicitation Panel (EOE) discussed in Appendix A of the Main Report. The steady flow model also uses the flows from the future analysis years (2044 and 2069). The 50%, 20%, 10%, 5%, 2%, 1%, .5%, and .2% event flows were run with the steady state model for each analysis year. The 10%, 2%, 1%, and .2% event flows were run with the unsteady state model.

Water surface profiles (WSP’s) were obtain from the hydraulic models. WSP’s show the flood elevation for each flood event at each cross section in the hydraulic model. WSP’s are primarily used in this analysis to estimate the stage-damage functions for each reach. The 8 profiles from the steady state model were used for the RRN in the metro area. The 10%, 2%, 1%, and .2% event profiles from the unsteady model were used to interpolate the 50%, 20%, 5%, and .5%, event profiles. These 8 WSP’s were used in the economic analysis along tributaries and the RRN outside the metro area.

Stage-flow curves (rating curves) are required wherever a flow-frequency curve is used in HEC-FDA. Rating curves were used for each reach index location on the RRN in the metro area. The WSP's were used to develop the rating curves up to the .2% event. For events larger than the .2%, stages were obtained by plotting the stage-discharge curve and extrapolating.

Rating curves and hydraulic conditions will likely remain constant throughout the period of analysis, although impacts from sedimentation have not been fully analyzed in a Sedimentation Impact Analysis. Some of the flood risk management measures would alter certain rating curves. Diversion channels can increase or decrease stages in the rating curve through the metro area by surcharging or reducing the water surface where the diversion re-enters the natural channel. This "backwater effect" occurs near the downstream end of the diversion channel and gradually diminishes upstream on the natural channel. The smaller the diversion capacity, the less affect there will be in the rating curves. With-project conditions were evaluated to reflect the changes in such rating curves, where appropriate. A normal distribution was assumed for each rating curve with varying standard deviations for each elevation.

All modeling in the Metro area reaches is based on the steady state hydraulic model, which routes flows through river cross sections to approximate water surface elevations. The unsteady model is utilizes storage cells as well as cross sections to simulate elevations. The steady and unsteady models use the same flows; however the unsteady model puts some of the flow in storage cells. The addition of storage cells makes the stages lower in the unsteady model than in the steady state model. For the purposes of economic modeling, there are two key differences between the steady state model and the unsteady model:

1. Storage cells take flows from cross sections and show lower stages through town. This tends to lower expected annual damage estimates and benefits.
2. Storage cells allow flows to damage areas that were not damaged in steady model. This tends to increase expected annual damage estimates and benefits.

The risks to plan evaluation from using the steady flow model are discussed in section 3.10.4.

The unsteady model was used to assess economic benefits and impacts for all reaches upstream and downstream of the metro, and for all tributaries.

3.4.4 Elevation-Frequency Curves

For reaches on tributaries and on the RRN outside the metro area, elevation frequency curves were used for the economic analysis. Elevation-frequency curves for each reach index location were obtained from WSP's. HEC-FDA automatically computed standard deviations for these curves based on a normal distribution.

A large part of Cass County falls within the storage cell areas of the unsteady flow model. The Sheyenne River storage area is located on the north side of the study area and west of Interstate Highway 29. This area is affected by combined RRN and Sheyenne River flows. For purposes of hydraulic analysis, this area has been divided into cells with boundaries consisting of the grid-

like road network. Each individual cell is treated like a separate point along a water surface profile with a related frequency-stage relationship that is applied to the structures within the cell. Elevation-frequency curves were used for this area,

Between Horace and the Sheyenne River storage areas the Sheyenne River poses the greatest flood threat. A ridge of higher ground runs generally north-south that serves as a natural divide between the Sheyenne River and RRN flood plains. Elevation-frequency curves are used in the economic analysis in this area of Cass County. This area is at reduced risk from flooding up to the median 1% flood profile by the Corps' Horace-to-West Fargo diversion project (Exhibit I displays the areas with flood risk management features and some additional geographic features).

The Minnesota diversions have no flood risk benefits on the Sheyenne, Maple and Rush Rivers. However, the North Dakota diversions benefit reaches along these tributaries.

3.5 Without-Project Conditions

3.5.1 Existing / Emergency Flood Risk Management Measures

3.5.1.1 Existing Levees

When evaluating future with- and without project conditions, consideration must be given to the existing levee/floodwall projects in place as well as emergency measures performed by the cities during flood events. One Corps levee, in place since the 1960's, reduces flood risk for neighborhoods south of downtown (Downtown South reach from river miles 452.0 – 452.7). The city of Fargo has added to this levee extending its line further south and reducing flood risk for additional neighborhoods (Near South reach from river miles 452.7 – 453.0). Another Corps project, currently under construction, reduces flood risk for the Ridgewood neighborhood on the north side of Fargo. Several other levee segments, some of which were constructed during past flood events, also provide moderate to significant levels of localized flood risk management. These levees can be raised and/or extended with additional earth fill or with sandbags as flood emergency efforts dictate. A geotechnical analysis has been performed for these in-place projects to determine the level of flood risk reduction credit to assign to them. However, they would be susceptible to flanking at their edges when floodwaters reach the local ground elevation. These temporary levees require additional fill and/or sandbags during a flood fight to extend the line of protection. The "weak link" therefore, in the line of protection may not be the levees themselves but rather the segments placed as part of the emergency operations to extend or close a line of protection. No credit for reducing flood risk is given to these emergency segments. For reaches with these types of levees, a zero-damage elevation has been estimated that reflects the local ground elevation rather than a probable failure elevation on the levee. The table below shows the existing levels of flood risk management for sub-reaches within the Fargo North reach prior to emergency actions.

Table C-4 Beginning Damage- Fargo North

Approximate zero-damage elevations in Fargo North Sub-reaches					
Subreach		Dnstrm	Upstrm		Zero-Damage
<u>Number</u>	<u>Subreach</u>	<u>Limit</u>	<u>Limit</u>	<u>Index</u>	<u>Elevation</u>
1	Fargo North End	438	447.3	442.7	895
2	Ridgewood	447.3	448.2	447.8	898.0 (TOL)
3	Near North	448.2	450.9	449.5	894.5
4	Downtown North	450.9	451.7	451.3	892.6
5	Downtown South	451.7	452.6	452.4	902.2 (TOL)
6	Near South	452.6	453	452.7	904.0 (TOL)
7	Lindenwood	453	455.3	454.2	900.6

Note: Corps projects (levees/floodwalls) in Subreaches 2 and 5; city project (levee) in Subreach 6; TOL = top of levee

A geotechnical failure analysis was included for the Near South levee (displayed in Exhibit I).

3.5.1.2 West Fargo

West Fargo is a larger city (2006 population of 20,681) within the study area. The Sheyenne River, a tributary of the Red River of the North, runs through town. A diversion/levee project constructed by the Corps of Engineers in the 1980's provides flood risk management from Sheyenne River flooding. However, flooding from a large RRN event can threaten the town from the east. Exhibit I displays the areas that are at a reduced risk of flooding through West Fargo.

West Fargo is divided into two reaches. The downtown reach is at reduced risk from Sheyenne River flooding by the Corps' diversion/levee project which is built to the median .2% flood profile or greater. This area is referenced to the RRN water surface profiles and includes a frequency-discharge relationship. The second reach, which extends from highway I-94 to the city's southern limit, is referenced to Sheyenne River water surface profiles which are expressed only in terms of frequency and elevation.

3.5.1.3 Other Local Flood Risk Management Features

Other local flood risk management projects, either in place or proposed and included as part of the future without-project condition include: the Horace to West Fargo diversion of the Sheyenne River (Corps-built project); Oakport (levee currently under construction, and property buyouts); and South Acres subdivision (levee). In addition to these structural projects, Fargo, with assistance from FEMA, has been actively acquiring flood prone properties and will continue to do so in the future. Properties currently planned for future buyout have been identified and removed from the structure inventory for damage/benefit evaluation purposes.

3.5.1.4 Geographic Features

A topographic ridge that generally runs North-South through the study area and separates the east part of Fargo from the west part and the City of West Fargo is of particular interest regarding lateral east-west flood flows from the Red River. This ridge acts as a natural flood barrier and provides a relative level of flood risk management to the west from Red River flooding. It also divides the floodplains of the Red and Sheyenne Rivers. Exhibit I displays the ridge alignment. Beginning damage elevations for structures on the west side of the ridge were adjusted as appropriate to account for the natural flood barrier.

3.5.2 Sewer backup flooding

A unique characteristic of flooding in the Fargo-Moorhead area is the potential for basement damage from backup of sanitary sewer lines. Homes not directly contacted by flood waters can incur basement damage via sewer lines originating from homes that are directly flooded. City officials contend that this is a major source of concern, and occurrences during past flooding and heavy rainfall/runoff events confirm this assertion. This phenomenon allows areas with a seemingly adequate level of topographic relief to incur indirect basement damage due to direct flooding of lower homes within the same sanitary sewer basin. A sanitary sewer basin is a subarea of the city in which all structures within the basin are connected to the same localized sewer system and whose drainage and flows to the sewage treatment plant are controlled by the same pump station. The zero-damage elevation for a particular basin is assumed to be the ground elevation of the lowest structure (plus 1 – 2 feet) in the basin. The basement of this lowest structure is assumed to be the entry point for flood waters into the local sewer basin which spread to other connected basements. Beginning damage elevations (HEC-FDA input data), typically set at a structure's ground elevation, are adjusted downward to the lower zero-damage elevation for the sanitary sewer basin.

3.5.3 Structure inventory

3.5.3.1 Metro Area

Structure data for the analysis of economic flood damages was obtained from Cass and Clay Counties and the cities of Fargo and Moorhead. Data was provided for all property parcels and included parcel ID numbers, structure values and structure types. In addition, field data was collected to confirm property types and locations and supplement data obtained from the cities and counties. Structures are categorized into the general categories of residential, apartment, commercial (includes industrial), public and agricultural.² Within each general category, structures are classified further and assigned a label referred to in the HEC-FDA data base as an occupancy name (Occ_Name). Each Occ_Name has its own depth-damage function which serves as the means for estimating damage by flood depth for the individual structure. See Table C-5 for structure count by category by area.

² Physical damage to agricultural structures was considered in this analysis, however no loss of agricultural production is considered.

Table C-5 HEC-FDA Structure Inventory Summary

Damage Reach	Apartment	Commercial	Public	Residential	Total
Fargo	1004	4503	393	21505	27405
West Fargo	113	842	11	7300	8266
Stanley Twp		24	2	513	539
Horace		35	6	634	675
Frontier		2		80	82
Prairie Rose				21	21
Briarwood				28	28
Pleasant Twp		15		27	42
North River				24	24
Reiles Acres				128	128
Harwood		9		243	258
Harwood Twp				99	99
Raymond Twp		1		16	17
Reed Twp		15		409	424
North Dakota subtotal	1117	5345	404	28805	35671
Moorhead & Greater Clay Co.	640	950	134	9148	10872
Total	1757	6396	552	40175	48880

3.5.3.2 Upstream and Downstream Areas

Field surveys were conducted for nearly all structures upstream and downstream of the Fargo Moorhead Metro. Information collected included structure type, condition, quality, foundation height, photographs, and other information for valuation of structures. Supplementary information was gained from Google maps street view or aerial imagery where needed. The upstream end of the inventory extends to Abercrombie, ND (but does not include it). The downstream end of the inventory extends to the Canadian border; however it is truncated at Thomson, ND at the downstream limit of the hydraulic model for the ND35K alternative.

3.5.3.3 Structure elevations

Structure elevation data is also required as input for the HEC-FDA model. In the spring of 2008, LiDAR digital elevation data was collected for the entire study area as part of the Red River Basin Mapping Initiative. The cities of Fargo and Moorhead provided shapefiles with building footprints for each structure within the city. Shapefiles with parcel footprints were available for the rest of the study area. Using GIS techniques, elevations were assigned to each building or parcel footprint based on the 2008 LiDAR. For structures with a building footprint, the lowest-adjacent-grade (LAG) was directly approximated. For structures with parcel footprints, either the mean or maximum parcel elevation was used to approximate the LAG.

First floor elevations were estimated based on a sample of structures surveyed for the height of the first floor above known ground elevations (foundation height). For West Fargo and nearly all of Cass County, each structure was surveyed (windshield) to estimate a foundation height. Approximately 970 structures in Fargo and Moorhead were surveyed (transit) by a local engineering firm (Houston) to collect first floor elevations. Houston measured the ground and first floor elevations at the front door of each sampled structure. An average difference between the surveyed first floor elevation and the LAG (LiDAR) was calculated for each occupancy type (one story, church, commercial, etc.). The resulting average foundation heights were applied to each structure in Fargo and Moorhead according to its occupancy type. URS Group Inc. submitted a report (attached) of the field work done as part of this study effort.

Beginning damage elevations for all non-residential structures and residential structures not on a sewer basin were assumed to be the LAG, unless there was a geographic feature or levee providing flood risk management to the structure. In such cases the beginning damage elevation was set at the top of the feature or levee. For residential structures on sewer basins, beginning damage elevations were assigned as described in section 3.5.2.

Due to the size of the study area and number of structures therein, it was not possible to obtain a direct estimate of uncertainty in structure elevations. The 2008 Red River Basin LiDAR has a margin of error of 1 ft (it supports 2 ft contours). Therefore, a standard deviation of ½ ft was used for the uncertainty in first floor elevations (using a normal distribution, the 95% confidence limit is two standard deviations on either side of the median value, which yields the 1 ft margin of error in the LiDAR).³

3.5.3.4 Structure values

Residential structure values were obtained from the respective assessors' offices (Fargo, Moorhead, Cass County and Clay County). Field data was collected and depreciated replacement values (DRV) were determined for a sample of structures (approximately 3,200 in the Metro and 90 upstream and downstream) throughout the study area using the Marshall-Swift cost estimating package.

³ Note, section 4.0 of the URS report estimates the difference between surveyed ground elevations and ground elevations provided by USACE. However, due to the fact that the surveyed elevations were taken at the front of each structure, and the estimates by USACE are based on the LAG, the two estimates cannot be directly compared, nor can the surveyed elevations be used to approximate the uncertainty associated with LiDAR elevations.

For the Metro area the DRV's were compared with the sampled structures' assessed values in order to derive a factor for converting the values for all structures to a DRV basis. To convert assessed values to DRV's for Fargo and Cass County residential structures, a factor of 1.28 is applied and for Moorhead and Clay County, a factor of 1.3 is applied. All non-residential structures (commercial, industrial, public) were inventoried for the purpose of identifying damageable properties and for assigning depreciated replacement values. The inventory included field surveys to collect data on structure characteristics as input for the Marshall & Swift value estimation process. Since all structures were surveyed and assigned a value from the M&S estimator, no factor was necessary for application to non-surveyed structures as was done for the residential structures.

For the upstream area, structures were classified into like categories (e.g. two-story with basement, good condition, etc.) and assigned values based on a dollar-per-square-foot basis obtained from the sampled structures.

For all structures, it is assumed that structure value is a normally distributed random variable with a 5% standard deviation.

3.5.3.5 Damage categories

Flood damage to buildings includes the standard categories of structure and contents. Each building is labeled with a code, referred to in HEC-FDA as an occupancy name (Occ_Name), that links it to structure and content depth-damage functions specific for that type of property.

For commercial and public structures, separate depth-percent damage functions (DDF's) recently developed by IWR are applied to structure and content values to estimate damage by flood depth (Source – Solicitation of Expert Opinion Depth-Damage Function Calculations for the Benefit-Cost Analysis Tool (Draft Report), October 2008). The associated standard deviations are also used to address the uncertainty inherent with these functions. Content values are determined by applying unique content-to-structure value ratios (CSVSR's) to the structure values themselves. To supplement the standard DDF's, field interviews were conducted for 33 of the larger and more unique commercial/industrial and public properties. The interviews were used to develop unique DDF's for contents of these properties while their structural damage was estimated using the standard DDF's for structures.

An estimation of uncertainty in the depth-damage relationship was obtained for each of the 33 interviewed structures. Damage was either normally or triangularly distributed at each depth. The standard deviation or high and low bounds were included in the DDF input in HEC-FDA.

Residential damage is estimated using the generic DDF's for structure and content damage provided in Economic Guidance Memorandum 04-01. Structure and content damages are both expressed as a percentage of structure value. The content damage functions are based on a content-to-structure value ratio of 100%. In addition to mean percent damage values by depth, EGM 04-01 also provides standard deviations which HEC-FDA uses to address uncertainty.

Residential structures are divided into seven types (i.e., Occ_Names) which include: one-story with and without basement; two or more stories with and without basement; split level with and without basement; and bi-level, among others.

3.5.3.6 Other Damage

In addition to structure and content damage, flood victims incur other costs. In an effort to quantify these other costs, a post-flood survey was conducted at Grand Forks and East Grand Forks (GF/EGF) after the flood of April 1997. This survey found that flood victims incur significant costs besides damage to their residential property and its contents. These include expenditures for travel, lodging and meals while evacuated from their homes; flood-related medical costs; vehicle damage; costs related to vandalism, looting and theft; cleanup costs including unpaid labor; and any other costs caused by flooding and not included as typical structural or content damage. Table C-6 summarizes the results of the post-flood survey and categories of other costs incurred by residents from the GF/EGF flood of 1997.

Table C-6 Other Flood Damage

Other Flood Damage per Residence			
Grand Forks			
<u>Category</u>	<u>100-Yr Floodplain</u>	<u>100 - 500-Yr Floodplain</u>	<u>East Grand Forks 500-yr floodplain</u>
Vehicle	\$4,227	\$493	\$1,531
Travel	2,442	557	1,849
Meals	1,155	607	391
Cleanup supplies	1,029	665	432
Unpaid labor	2,643	1,377	1,834
Moving, storage	144	5	37
Vandalism, etc	126	7	25
Medical	125	78	732
Other	<u>645</u>	<u>41</u>	<u>789</u>
Total	12,536	3,829	7,620

A regression equation was developed from the GF/EGF survey data relating damage to depth of flooding. The parameters have been updated using the consumer price index for urban consumers. The equation, which represents an average relationship for all residential structures, is as follows:

$$\text{Other Damage} = (\$1,636 \times \text{Depth}) - \$7,254$$

Based on this equation, other damage starts when water depth in the basement reaches 4.5 feet. For residential structures without basements, other damages are assumed to begin at a flood elevation within one foot of the first floor of the structure. It is within this range that evacuation is assumed to commence and related costs start accruing. To apply this equation in the FDA model a depth-percent damage relationship was developed. Percent damage refers to damage expressed as a percent of other value. Each residential structure was assigned an arbitrary other value of \$100,000. The regression equation was evaluated for a range of depths. For each depth, the resulting dollar figures were converted to percentages of \$100,000. This percent-depth damage function was entered into FDA. The depth-percent damage relationship is displayed below. Apartments are assigned the same other damage relationship as residential structures.

Table C-7 Other Depth-Percent Damage

Depth (feet above basement floor)	Damage as % of other value (\$100,000)
-4	0
-3	0.90%
-2	2.60%
-1	4.20%
0	5.80%
1	7.50%
2	9.10%
3	10.70%
4	12.40%
5	14.00%
6	15.70%
7	17.30%

Other damage is assumed to be a normally distributed variable with a standard deviation of 10%.

3.6 Existing and Future Economic Conditions

As discussed in section 3.4, flood risk and comparison of alternatives was evaluated for three analysis years: 2018, 2043 and 2068. The analysis years were selected based on anticipated changes in hydrologic conditions. At present, the Red River Basin is in a “wet” period, meaning that each level of flow is associated with a relatively high frequency. In future years each level of flow is expected to become less frequent. It was necessary to evaluate economic conditions for each of the analysis years.

The city of Fargo will continue to develop to the North and South. City ordinance requires all new development in the floodplain to be flood proofed to an elevation 2 ft above the Federal Emergency Management Agency (FEMA) 1% flood event profile. Future development was analyzed based on the Fargo Growth Plan (2007). The city will grow approximately 266 acres each year; approximately 52% of new development will be residential, while 48% will be commercial. The new structures were placed geographically as described in the Fargo Growth Plan. Based on these assumptions flood risk was calculated for the appropriate number of additional structures in each analysis year.

Based on discussions with the City of Fargo and Cass County, a large flood risk management structure would reduce the need for flood-proofing of new development. For the diversion alternatives, new development was on average assumed to be built 2 ft. lower than under without-project conditions (this varied by location). Flood proof cost savings benefits are discussed in section 3.7.6.

3.7 Damages and Benefits

3.7.1 Damage to Existing and Future Development

Most of the flood risk in the study area is comprised of damage to homes, businesses, and other buildings in the floodplain. Damages to existing and future development were calculated from the structure inventory (see section 3.5) using HEC-FDA. Stage-damage relationships for buildings in the study area were developed for with- and without-project conditions (for each reach and each damage category). Stage damage relationships for with-project conditions include future development at a lower elevation than under without-project conditions. In all other respects stage-damage relationships are the same under with- and without-project conditions (except where easements are needed for an alternative). Stage-damage curves for existing conditions (2011) are presented in Exhibit G.

EAD, for each alternative (except the ND w/staging) and analysis year was computed using HEC-FDA based on frequency, rating, and damage curves. The benefits for the North Dakota East Alignment 35,000 cfs plan (ND35k), as with the Minnesota plans, were modeled using the Phase III steady model. The North Dakota East Alignment 20,000 cfs with Upstream Staging (ND w/Staging) was developed in Phase IV; however, the stages approximately match those of the ND35k. Therefore, benefits for the ND w/Staging alternative are approximated using the results of the ND35k plan. This is discussed in more detail in section 3.10.5.

For Minnesota diversion, feasible non-structural measures were found in areas of Cass County (see Appendix P of the Main Report). These measures are in reaches not benefited by Minnesota diversions, particularly reaches along the tributaries. For this reason it was not necessary to adjust the structure inventory or stage-damage curves in HEC-FDA for the analysis of Minnesota diversions.

EEAD for each alternative was computed using standard present value and annualizing formulas - using the appropriate discount rate and period of analysis. The benefit of each alternative is the difference between without project EEAD and with project EEAD. This difference is the equivalent expected annual benefit EEAB.

EAD for existing conditions (2011) and each analysis year without project is presented in Table C-8. For the metro area, EAD increases until the base year (due to development), then decreases (due to changing hydrology). It is assumed that the change in EAD can be interpolated linearly between the analysis years. The linear interpolation serves as the basis for computing EEAD. EEAD for each alternative is presented in Table C-9. Table C-10 shows EEAB for each alternative.

EAD in the metro area for existing conditions is estimated at \$177,743,000. Note that this is expected annual damage with existing and proposed projects in place but prior to additional emergency actions. Metro area EEAD is \$183,792,000. A summary of existing conditions expected annual damage by reach and category is presented in exhibit H. Equivalent expected annual damage computations are displayed in Exhibit L.

In order to isolate the effects of future development versus hydrologic changes, damages were calculated using existing economic conditions for each analysis year (holding hydrology input constant in each year). Results of this analysis are presented in Exhibit L. Future growth accounts for 14% of EEAD (no damage occurs below the FEMA 1% flood elevation).

EAD and EEAD are presented in greater detail (by reach and by category) in Exhibit L.

Table C-8 EAD without Project Conditions - Development – (\$1,000's)

Year	Metro Area	Upstream	Downstream
2011	\$177,743	\$693	\$763
2019	\$186,442	\$693	\$763
2044	\$173,916	\$693	\$763
2069	\$157,486	\$693	\$763

Table C-9 EEAD by Alternative – Development (\$1,000's)

Plan	Metro Area	Upstream	Downstream
Without Project	\$183,792	\$693	\$763
ND w/Staging**	\$30,997	\$183	\$646
ND-E-35k	\$30,997	\$729	\$879
MN-S-45k	\$21,873	*	*
MN-S-40k	\$24,894	*	*
MN-S-35k	\$28,957	\$729	\$879
MN-S-30k	\$35,667	*	*
MN-S-25k	\$41,369	*	*
MN-S-20k	\$55,092	*	*

*Not analyzed

**The operating plan for this alternative is not firm.
The benefits shown downstream will likely not .
likely occur with the final operating plan. Some
adverse impacts may occur.

Table C-10 EEAB by Alternative – Development (\$1,000's)

Plan	Metro Area	Upstream	Downstream
Without Project	\$0	\$0	\$0
ND w/Staging**	\$152,795	\$509	\$0
ND-E-35k***	\$152,795	(\$36)	(\$116)
MN-S-45k	\$161,919	*	*
MN-S-40k	\$158,898	*	*
MN-S-35k***	\$154,835	(\$36)	(\$116)
MN-S-30k	\$148,125	*	*
MN-S-25k	\$142,423	*	*
MN-S-20k	\$128,700	*	*

*Not analyzed

**Benefits downstream adjusted. Some adverse
impacts may occur

***Benefits are shown as negative. These are
opportunity costs of the alternative and have
been add to the cost side

3.7.2 Emergency costs

The cities of Fargo and Moorhead incur significant costs in flood fight efforts. A large part of these costs are for construction of earthen and sandbag levees (labor, equipment, materials, etc.). During large flood events, the cities build as many as 46 miles of emergency dikes and levees through town in an effort to retain flood waters. When flood waters recede, these levees must all be removed. Additional costs are incurred for emergency and other public services (police, medical, public works, National Guard, etc.) related to the flood fight. Businesses, residents, federal agencies, local and state governments, as well as humanitarian organizations such as the Red Cross, Salvation Army, and local churches all contribute to the flood fight, rescue and clean-up efforts.

The method used to quantify these costs was based on historical flood data collected through interviews with key agencies. Interviews were conducted with FEMA, the North Dakota National Guard, the ND Department of Human Services, the Red Cross, the Salvation Army, as well as the cities of Fargo and Moorhead. The data collected is based on six major floods: Fargo 1989, Grand Forks 1997, Fargo 1997, Fargo 2001, Fargo 2006 and Fargo 2009. Whenever possible, cost reports were obtained from the agencies involved in each flood event. In the absence of cost reports, estimates were obtained from individuals who were considered experts on the given flood event (e.g. the regional director of the Red Cross). For some costs, such as the number of volunteer hours contributed to flood fighting, data was not readily available. These costs were not included in the final emergency cost estimates. However, based on sensitivity analysis the missing costs do not amount to more than 3% of the emergency cost estimates.

The 1997 Grand Forks event was approximately a .5 % chance event. In order to account for the size difference between Fargo and Grand Forks, the emergency cost estimate for this event was increased. Emergency costs were multiplied by a factor equal to the population of Fargo and Moorhead, divided by the population of Grand Forks and East Grand Forks (population factor).

The 2001 and 2006 Fargo events were similar events. The cost estimates for these two events were averaged to estimate damages a stage of 37.88. The 1997 and 2009 Fargo events were likewise averaged to obtain an estimate of damage at a stage of 39.61.

The Fargo 1989 flood crested at a stage of 35.36. Construction of large scale emergency measures begin at a stage of 35 ft. Table C-11 displays the resulting stage-damage curve for Fargo-Moorhead emergency costs. All costs have been brought to present (2009) dollars. A standard deviation of 10% was used to account for uncertainty in the valuation of emergency costs.

Table C-11 Emergency Cost Stage-Damage Function (\$1,000's)

Stage ft. (Gage)	Stage ft.	Damage	St.
31	893.74	\$0	\$0
35.36	898.1	\$940	\$94
37.88	900.62	\$2,050	\$205
39.61	902.35	\$64,000	\$6,400
42.19	904.93	\$262,740	\$26,274

The stage-damage curve for emergency costs was manually entered into HEC-FDA. Expected annual emergency costs were computed for each analysis year. The existing conditions (2011) expected annual damage is \$7,739,000.

Emergency costs were analyzed for the Fargo Moorhead Metro only. Historically, flood fights and emergency costs have not been as significant for the impacted areas upstream or downstream, which are mostly rural, as they are for the Metro, which is a large urban area. Grand Forks North Dakota and East Grand Forks Minnesota are in the downstream affected area; however a large flood risk management project is in place in that community. Therefore, emergency costs for rural areas and for Grand Forks/ East Grand Forks are not expected be large enough to alter the results of the NED analysis.

EAD, EAB, and EEAD for the Emergency category are displayed in Tables C-15 though C-17.

3.7.3 Sewer and Infrastructure Damage

The cities of Fargo and Moorhead incur damages to sewer systems, roads and other infrastructure during major flood stages. The cities of Fargo and Moorhead provided records of sewer and road repairs that occurred due to past floods. These figures were indexed to current dollars (2010) and related to the stage associated with the historic flood. The following stage-damage curve was produced based on historical flood damage to sewer and infrastructure.

Table C-12 Sewer and Infrastructure Damages (\$1,000's)

Stage ft. (Gage)	Elevation at RM	Damage	St.
	452.7	(1,000)	Dev.(1,000)
30	892.74	\$0	\$0
37.13	899.87	\$343	\$34
39.72	902.46	\$3,691	\$369
40.82	903.56	\$6,638	\$664

This stage damage function was manually entered into HEC-FDA. Expected annual sewer and infrastructure damages were computed for each analysis year. The existing conditions expected annual damage is \$291,000.

Sewer and infrastructure damages were analyzed for the Fargo-Moorhead Metro area only. These damages are expected to be relatively small in the downstream and upstream affected areas (which are mostly rural). As mentioned above, Grand Forks and East Grand Forks have a flood risk management project, and sewer and infrastructure damages are not expected to be high for those communities. Therefore, sewer and infrastructure damages outside the metro are expected to be small enough that they will not affect the NED analysis.

EAD, EAB, and EEAD for the Sewer & Infrastructure category are displayed in Tables C-15 through C-17.

3.7.4 Transportation costs

A stage-damage function was produced for transportation damages. See attachment 2-Transportation Analysis- for details of this calculation. Table C-13 displays the resulting stage damage function. The stage damage function was manually entered into HEC-FDA. Expected annual transportation damage for transportation costs was computed for each analysis year. The existing conditions expected annual damage is \$4,029,000.

Table C-13 Transportation Stage-Damage Function (\$1,000's)

Stage ft. (Gage)	Stage ft. (elevation at RM 452.7)	Damage (1,000)	St. Dev.(1,000)
20.26	882.87	\$0	
28.53	891.15	\$0	
32.52	895.14	\$1,125	\$113
35.1	897.71	\$1,442	\$144
37.87	900.48	\$3,934	\$393
39.61	902.21	\$82,958	\$8,296
42.19	904.77	\$85,962	\$8,596
44.02	906.59	\$90,275	\$9,028

Transportation costs were only analyzed for the metro area. Transportation costs outside the metro and induced transportation costs due to project construction were not quantified. This is a source of uncertainty in the NED analysis. These costs are not expected to be larger than the costs for without project conditions for the Metro area; however no sensitivity analysis has been conducted to verify this claim. Based on professional judgment, it is unlikely that the inclusion of these costs would alter the results of the NED analysis.

EAD, EAB, and EEAD for the Transportation category are displayed in Tables C-15 through C-17.

3.7.5 Flood proofing Cost Savings Benefits

Currently, new development in the floodplain in Fargo and Cass County requires flood proofing to reduce the threat of flood damage in the future and meet FEMA regulations. Savings of the cost to flood proof new construction is a benefit of a flood risk management project that can reduce the footprint of the floodplain. The area benefited is that area removed from the 100-year floodplain by the project that would have been developed in the future with flood proofing measures implemented.

Urban development in the study area has been expanding and will continue to expand over the course of the planning period. Fargo's population has grown from 47,000 in 1960 to over 93,000 in 2006, an average growth rate of over 2 percent per year (straight-line growth). To accommodate this growth, Fargo development has increased in recent years at an average rate of 266 acres per year. The Fargo Planning Department has projected urban growth for the next 50 years. They use this figure of 266 acres for projecting future development demand (Source: Growth Plan 2007 – City of Fargo, North Dakota). Growth is projected to occur within two development "tiers". Tier 1, an area adjacent to the present Fargo city limits, is sized to accommodate 25 years of growth at approximately 266 acres per year. Tier 2 is comprised of areas further away from the existing city and is expected to accommodate growth 25-50 years in the future. For years 25 through 50, it is assumed that development will continue at the rate of 266 acres per year. Each tier has a spatial component on both the north and south sides of town. In both Tier 1 and Tier 2 most future growth will occur within the 100-year flood plain and, without a flood risk management project, require flood proofing. In addition, within the city limits of Fargo itself, some acreage within the 100-year floodplain is also available for future development. Growth is expected at the same rate of 266 acres per year regardless of the need for flood proofing or not. Much of the area available for future growth is within the 100-year floodplain and future development with a diversion project in place would benefit from the saving of flood proofing costs in those areas removed from the floodplain.

Flood proofing measures include raising the grade of developable land with fill, waterproofing basement foundations, and building ring dikes around developable parcels. In addition to the direct construction cost is the opportunity cost of reduced revenue in the form of lost lot sales (estimated at up to \$40,000 per acre) as flood proofed land is less intensively developed from a structural standpoint than non-flood proofed land. The type of flood risk reduction provided would vary by land use. Commercial, industrial, and public/institutional land uses would most likely elevate because of the high cost of their facilities and the ability to pay for higher land costs. Cost for this measure ranges from \$55,000 to \$70,000, by either elevating the entire site or acquiring additional properties for fill to elevate their buildings and facilities. For instance, a new Wal-Mart in south Fargo elevated the entire site, building and parking lot. These types of land use would use approximately 42% of the projected developable land area.

Residential and park land uses would more likely ring dike because the cost would be lower and these land uses seek lower cost land to make the housing feasible. Additional cost to develop in this manner is estimated at \$35,000 per acre. Costs can range higher, however, for the more expensive residential development projects that, like commercial projects, involve the placement of fill to raise the grade of their lots and adjacent ancillary uses. These land uses are estimated to use approximately 58% of the projected developable land area. The percentage estimates are based on current and projected land use in the Fargo Growth Plan. Exhibit N presents the calculation of the flood proofing cost savings benefit per acre of development on a weighted average basis. This benefit is expected for each of the diversion alternatives since each will reduce the flood plain footprint sufficiently to accommodate future demand for flood-free developable land.

Table C-14 Flood proofing Cost Savings Benefit per Acre

<u>Type</u>	<u>Percent</u>		<u>Cost per acre</u>	<u>Wtd average</u>
	<u>Land use</u>			
Comm/ind/public	42%		\$62,500	\$26,250
Residential	58%		\$35,000	\$20,300
Wtd average cost / acre				\$46,550

Source: Fargo Department of Planning

The savings per acre is applied to the average acres per year developed on land converted from floodplain to non-floodplain by a diversion project. Floodplain maps for without and with-project conditions were used to estimate the amount of land formerly in the floodplain that would realize the flood proofing cost savings benefit. At the rate of 266 acres per year, the future demand for developable land over the 50-year planning period is 13,300 acres. Growth is assumed at the same rate for the interim period between 2010 and the base year of 2018. Development in the floodplain within this period would require flood proofing and incur the related costs. This land (266 acres/year x 8 years = 2,128 acres) would not be expected to realize the cost savings benefit. Land within Tier 1 and the Fargo city limits would be projected to be developed before Tier 2 land regardless of its location relative to the floodplain. This is in keeping with the city's planning goal to grow in an orderly and efficient manner. There are approximately 20,000 acres within Tiers 1 and 2 and in Fargo available for future development to the year 2068 so supply exceeds demand for the foreseeable future. Of this land, approximately 14,000 acres is within the present 100-year floodplain. As expected, the larger the diversion project, the larger the area removed from the 100-year floodplain and the larger the expected annual flood proofing cost savings. Exhibit L displays the acres by plan opened up to development free of flood proofing requirements, land outside of the floodplain used to meet growth demand, and residual acreage that may still require flood proofing to meet demand. Annual benefits are also estimated by applying the weighted average flood proofing cost per acre to the average annual acres benefited by plan. Average annual benefits range from \$5.4 million for the MN Short 20k cfs diversion to \$10.4 million for the ND 35k cfs diversion.

3.7.6 Flood Insurance Administration Cost Savings Benefits

A project that eliminates the threat of flooding from a 100-year flood event in the flood plain also eliminates the requirement for flood insurance for properties in the flood plain. A benefit can be claimed for saving the cost of administering the flood insurance policies as structures are no longer subject to flooding from a 100-year event. Per Economic Memorandum #06-04 dated April 6, 2006, the annual administration cost for flood insurance policies is \$192. Currently there are 5,082 flood insurance policies in effect in the study area (Source: FEMA Region VIII office). This includes the cities of Fargo and Moorhead and the counties of Cass and Clay. Total administration costs associated with these policies amounts to \$975,700. This is the benefit to a flood risk management project for eliminating the 100-year flood plain and the requirement to purchase flood insurance. This benefit applies to each of the diversion alternatives.

3.7.7 Non-Structural Benefits

Appendix P of the Main report contains the evaluation of non-structural measures. The incremental EEAB for non-structural measures are present in Table C-16

Table C-15 Non-Structural EEAB (\$1,000's)

Plan	EEAB
Without Project	0
ND w/Staging	0
ND-E-35k	0
MN-S-45k	414
MN-S-40k	414
MN-S-35k	414
MN-S-30k	414
MN-S-25k	414

3.7.8 Recreation Benefits

Recreation features were formulated for each diversion alignment in Appendix M of the Main Report. The annual benefits for recreation plans from Appendix M are \$4,806,000 with North Dakota diversions and \$5,004,000 for Minnesota diversions.

3.7.9 Damage and Benefit Summary

Table C-16 through Table C-20 summarize the EAD, EEAD, EEAB, and other benefits discussed in the previous sections.

Table C-16 EAD without Project Conditions – Emergency Etc. (\$1,000's)

Year	Metro Area		
	Emergency	Sewer&Infra	Traffic
2011	\$7,739	\$291	\$4,029
2019	\$7,739	\$291	\$4,029
2044	\$6,311	\$237	\$3,290
2069	\$5,239	\$197	\$2,728

Table C-17 EEAD by Alternative - Emergency Etc. (\$1,000's)

Plan	Metro Area		
	Emergency	Sewer&Infra	Traffic
Without Project	\$7,063	\$266	\$3,679
ND w/Staging	\$648	\$22	\$333
ND-E-35k	\$648	\$22	\$333
MN-S-45k	\$369	\$16	\$242
MN-S-40k	\$489	\$20	\$297
MN-S-35k	\$646	\$25	\$372
MN-S-30k	\$916	\$34	\$483
MN-S-25k	\$1,111	\$41	\$579
MN-S-20k	\$1,607	\$62	\$839

Table C-18 EEAB by Alternative – Emergency Etc. (\$1,000's)

Plan	Metro Area		
	Emergency	Sewer&Infra	Traffic
Without Project	\$0	\$0	\$0
ND w/Staging	\$6,415	\$244	\$3,346
ND-E-35k	\$6,415	\$244	\$3,346
MN-S-45k	\$6,694	\$250	\$3,437
MN-S-40k	\$6,574	\$246	\$3,382
MN-S-35k	\$6,417	\$241	\$3,307
MN-S-30k	\$6,147	\$232	\$3,196
MN-S-25k	\$5,952	\$225	\$3,100
MN-S-20k	\$5,456	\$204	\$2,840

Table C-19 EEAD Summary (\$1,000's)

Category	Without	NDw/Staging	ND-E-35k	MN-S-45k	MN-S-40k	MN-S-35k	MN-S-30k	MN-S-25k	MN-S-20k
EEAD Development Metro	\$183,792	\$30,997	\$30,997	\$21,873	\$24,894	\$28,957	\$35,667	\$41,369	\$55,092
EEAD Emergency	\$7,063	\$648	\$648	\$369	\$489	\$646	\$916	\$1,111	\$1,607
EEAD Sewer&Infra	\$266	\$22	\$22	\$16	\$20	\$25	\$34	\$41	\$62
EEAD Transportation	\$3,679	\$333	\$333	\$242	\$297	\$372	\$483	\$579	\$839
Sub-Total Metro EEAD	\$194,800	\$32,000	\$32,000	\$22,500	\$25,700	\$30,000	\$37,100	\$43,100	\$57,600
EEAD Development Upstream	\$693	\$183	\$729	*	*	\$729	*	*	*
EEAD Development Downstream	\$763	\$646	\$879	*	*	\$879	*	*	*
Sub-Total Outside Metro EEAD	\$1,456	\$829	\$1,608	\$0	\$0	\$1,608	\$0	\$0	\$0
Total Study Area EEAD	\$196,256	\$32,829	\$33,608	\$22,500	\$25,700	\$31,608	\$37,100	\$43,100	\$57,600
**Not Analyzed									

Table C-20 EEAB Summary (\$1,000's)

Category	NDw/Staging	ND-E-35k	MN-S-45k	MN-S-40k	MN-S-35k	MN-S-30k	MN-S-25k	MN-S-20k
EEAB Development Metro	\$162,800	\$162,800	\$172,300	\$169,100	\$164,800	\$157,700	\$151,700	\$137,200
EEAB Emergency	\$6,415	\$6,415	\$6,694	\$6,574	\$6,417	\$6,147	\$5,952	\$5,456
EEAB Sewer&Infra	\$244	\$244	\$250	\$246	\$241	\$232	\$225	\$204
EEAB Transportation	\$3,346	\$3,346	\$3,437	\$3,382	\$3,307	\$3,196	\$3,100	\$2,840
Sub-Total Metro EEAB	\$172,805	\$172,805	\$182,681	\$179,302	\$174,765	\$167,275	\$160,977	\$145,700
EEAB Development Upstream	\$509	\$0	\$0	\$0	\$0	\$0	\$0	\$0
EEAB Development Upstream	\$0	*	**	**	*	**	**	**
Total FRM EEAB	\$173,314	\$172,805	\$182,681	\$179,302	\$174,765	\$167,275	\$160,977	\$145,700
EEAB Non Structural	\$0	0	\$414	\$414	\$414	\$414	\$414	\$430
Flood Insurance Admin. Benefit	\$958	\$958	\$1,000	\$1,000	\$1,000	\$1,000	\$1,000	\$1,000
Flood Proof Benefits	\$9,993	\$9,993	\$6,240	\$6,240	\$6,240	\$6,240	\$6,240	\$6,240
Total Alternative Benefits	\$183,756	\$183,756	\$190,335	\$186,956	\$182,419	\$174,929	\$168,631	\$153,370
Recreation Annual Benefit	\$4,806	\$4,806	\$5,004	\$5,004	\$5,004	\$5,004	\$5,004	\$5,004
*Factored in on cost side								
**Not Analyzed								

3.8 NED Costs

NED costs include the implementation costs of alternatives (including costs for mitigation of adverse impacts), opportunity costs of the investment (interest during construction), economic costs of unmitigated adverse impacts, and operation, maintenance, repairs, rehabilitations, and replacements (OMRR&R) of project features.

All costs and benefits must be compared on an annual basis, from a consistent point in time. Just as all benefits are compounded or discounted to the base year (2019) and annualized, so are all economic costs.

Screening of alternatives took place in both Phase III and Phase IV. Costs from both phases are present in this section. The costs from Phase III were developed in FY 2010, while costs from Phase IV were developed on FY 2011. The FY 2010 discount rate (4-3/8%) is used for Phase III and the FY 2011 discount rate (4-1/8%) is used for Phase IV. Similarly, price levels from 2010 and 2011 are used for Phase III and IV, respectively.

3.8.1 Installation and OMRR&R Costs

The cost estimates from appendix L for the Phase III and IV alternatives are presented tables C-19 and C-20.

Table C-21 Phase III Diversion Cost Estimates (\$1,000's)

Plan	Installation Costs	Annual OMRR&R
ND-E-35k	\$1,237,355	\$3,318
MN-S-35k	\$1,066,597	\$2,375
MN-S-30k	\$990,099	\$2,217
MN-S-25k	\$929,562	\$2,057
MN-S-20k	\$856,101	\$1,883

Table C-22 Phase IV Diversion Cost Estimates (\$1,000's)

Plan	Installation Costs	Annual OMRR&R
ND w/Staging	\$1,745,033	\$3,501
ND-E-35k	\$1,484,913	\$3,436
MN-S-35k	\$1,205,207	\$3,508

Detailed cost estimates were not developed for the MN-S-45k and MN-S-40k plans. In lieu of cost estimates for a Minnesota 40K CFS and Minnesota 45K CFS diversion, it was assumed that marginal costs were constant with respect to diversion capacity (KCFS). The

following regression equation was calculated based on cost estimates for the Minnesota 20K CFS through 35K CFS diversion:

$$\text{Annual Charges } (\$1,000) = (\text{KCFS} \times 860.01) + 35,900.8$$

$$\text{R-squared} = 0.99367$$

The projected annual charges for the 40K and 45K diversions are presented in Table C-23.

Table C-23 Projected Annual Charges (\$1,000's)

Plan	Annual Installation & OMRR&R Costs
MN-S-40k	\$70,301
MN-S-45k	\$74,601

3.8.2 Opportunity Costs of Investment

Outlays made during the construction of alternatives are made with no immediate return on investment. Those outlays could have otherwise been invested elsewhere and begin returns on investment immediately. The forgone return on investment is an opportunity cost of the alternative. The returns on investment are forgone at a rate equal to the discount rate (this represents the annual return on investment earned by investing in other water resource projects). Similarly, outlays made after the base year are discounted to reflect the benefit of not forgoing a return on investment. Alternatively, applying discounting and compounding principles is equivalent to taking the present worth (at the base year) of all outlays.

In both Phases III and IV, it was estimated that a North Dakota diversion would take 8.5 years to construct and a Minnesota diversion would take 7.5 years. It was assumed that the diversion first costs would be distributed equally through each year of construction. These outlays are compounded annually to the base year. Tables C-20 and C-21 display the present worth of installation costs for each alternative in Phases III and IV. The difference between the present worth and installation costs is interest during construction (IDC). Exhibit K shows the computational steps to determine IDC for Phases III and IV.

Table C-24 Phase III Interest during Construction (\$1,000's)

Plan	Installation Costs	IDC	Present Worth
ND-E-35k	\$1,237,355	\$224,548	\$1,461,904
MN-S-35k	\$1,066,597	\$219,368	\$1,285,965
MN-S-30k	\$990,099	\$203,635	\$1,193,733
MN-S-25k	\$929,562	\$191,184	\$1,120,745
MN-S-20k	\$856,101	\$176,075	\$1,032,176
Rec ND	\$34,753	\$760	\$35,513
Rec MN	\$34,242	\$2,280	\$36,522

Table 25 Phase IV Interest during Construction (\$1,000's)

Plan	Installation Costs	IDC	Present Worth
ND w/Staging	\$1,745,033	\$296,914	\$2,041,947
ND-E-35k	\$1,484,913	\$252,655	\$1,737,568
MN-S-35k	\$1,205,207	\$232,404	\$1,437,611
Rec NDwStaging	\$36,315	\$791	\$37,106
Rec ND35k	\$38,835	\$801	\$39,636
Rec MN	\$31,494	\$2,015	\$33,509

3.8.3 Economic Costs for Unmitigated Adverse Impacts

Diversion alternatives have a large footprint and greatly affect flood behavior. As a result, a number of economic, social, and environmental impacts occur, some adverse. Costs for mitigation of environmental impacts are included in the installation costs. These mitigation measures are discussed in section 5.5 of the Main Report. Economic and social impacts are mitigated to some extent, where takings are required, or where property is needed for project features (such as the staging area for the ND w/Staging alternative). These mitigation costs are included in the installation costs as well. For the most part, economic and social impacts are not mitigated with the diversion alternatives. Social impacts are discussed in Appendix D and in section 5.2.3 of the Main Report (consideration is also given to Environmental Justice issues in accordance with Executive Order 12898). The costs of unmitigated economic impacts were analyzed and to some extent quantified. The impacts that have been quantified are the induced flood risk impacts. Other economic impacts are discussed in Appendix D and in section 5.2.3 of the Main Report.

Induced flood damage was analyzed using HEC-FDA. There are induced damages upstream and downstream for Minnesota and North Dakota diversion. These damages were not fully analyzed in Phase III. Phase IV has included a preliminary identification of induced damages.

Table C-26 Phase IV Induced Damage (\$1,000's)

Plan	Upstream	Downstream	Total
ND w/Staging*	-	-	-
ND-E-35k	\$36	\$116	\$153
MN-S-35k	\$36	\$116	\$153
*Some adverse impacts may occur.			

3.8.4 NED Cost Summary

Table C-27 and Table C-28 display the NED costs discussed in the previous sections.

Table C-27 Phase III NED Costs (\$1,000's)

	ND35K	MN45K	MN40K	MN35K	MN-S-30k	MN-S-25k	MN-S-20k
Total Diversion First Cost	\$1,237,355		*	* \$1,066,597	\$990,099	\$929,562	\$856,101
Present Worth of Investment	\$1,461,904		*	* \$1,285,965	\$1,193,733	\$1,120,176	\$1,032,176
Annual Diversion Investment Cost	\$72,477		*	* \$63,754	\$59,182	\$55,535	\$51,172
Annual Diversion O&M Cost	\$3,318		*	* \$2,375	\$2,217	\$2,057	\$1,883
Induced Damages	**	**	**	**	**	**	**
Annual Diversion Charges	\$75,795	\$74,601	\$70,301	\$66,129	\$61,399	\$57,592	\$53,055
Total Recreation First Cost	\$34,753	\$34,242	\$34,242	\$34,242	\$34,242	\$34,242	\$34,242
Present Worth of Investment	\$35,513	\$36,522	\$36,522	\$36,522	\$36,522	\$36,522	\$36,522
Annual Recreation Investment Cost	\$1,761	\$1,811	\$1,811	\$1,811	\$1,811	\$1,811	\$1,811
Annual Recreation O&M Cost	\$47	\$47	\$47	\$47	\$47	\$47	\$47
Annual Recreation Charges	\$1,808	\$1,858	\$1,858	\$1,858	\$1,858	\$1,858	\$1,858

Table C-28 Phase IV NED Costs (\$1,000's)

	ND w/Staging	ND35K	MN35K
Total Diversion First Cost	\$1,745,033	\$1,484,913	\$1,205,207
Present Worth of Investment	\$2,041,947	\$1,737,568	\$1,437,611
Annual Diversion Investment Cost	\$97,097	\$82,623	\$68,360
Annual Diversion O&M Cost	\$3,501	\$3,436	\$3,508
Induced Damages	-	153	153
Annual Diversion Charges	\$100,598	\$86,212	\$72,021
Total Recreation First Cost	\$36,315	\$38,835	\$31,494
Present Worth of Investment	\$37,106	\$39,636	\$33,509
Annual Recreation Investment Cost	\$1,764	\$1,885	\$1,593
Annual Recreation O&M Cost	\$130	\$130	\$40
Annual Recreation Charges	\$1,894	\$2,015	\$1,634

3.8.5 NED Results, Net Benefits and Benefit-Cost Ratios

Table C-29 and Table C-30 display the comparison of benefits and costs for Phase III and Phase IV alternatives. The MN40K plan was identified in Phase III as the NED plan (the plan that reasonably maximizes net benefits). As discussed in Chapter 3 of the Main Report, the local study sponsors requested that the Corps recommend the ND35K as the Locally Preferred Plan (LPP). Since the ND35K had fewer benefits and more costs than the NED plan, the MN35K was selected for the basis of the federal cost share, making it the Federally Comparable Plan (FCP).

At the end of Phase III, the upstream and downstream impacts of the diversion alternatives had yet to be fully defined. Impacts were further defined, and the concept of staging measures was introduced in Phase IV. The analysis in Phase IV is based only on the ND w/Staging, the ND35K, and the MN35K. In Phase IV, the local study sponsor indicated that the preferred plan was the ND w/Staging. The St Paul District maintains that the Phase III identification of the NED plan was still valid in Phase IV, and that the current NED plan is the MN40K. The ND w/Staging is referred to as the LPP. The MN35K remains the FCP. For further discussion of the identification of the NED, LPP and FCP see Chapter 3 of the Main Report.

The project performance analysis is discussed in section 3.9 of this appendix. A sensitivity analysis of the economic analysis based on emergency flood-fights is discussed in section 3.10.1 of this appendix. Other risks and uncertainties in the economic analysis are discussed section 3.10 of this appendix.

Table C-29 Phase III Net Benefits and Benefit-Cost Ratios (\$1,000's)

	ND-E-35k	MN-S-45k	MN-S-40k	MN-S-35k	MN-S-30k	MN-S-25k	MN-S-20k
Total Alternative Benefits	\$183,756	\$190,335	\$186,956	\$182,419	\$174,929	\$168,631	\$153,370
Annual Diversion Charges	\$75,795	\$74,601	\$70,301	\$66,129	\$61,399	\$57,592	\$53,055
Net Benefit	\$107,961	\$115,734	\$116,655	\$116,290	\$113,530	\$111,039	\$100,315
Benefit-Cost Ratio	2.42	2.55	2.66	2.76	2.85	2.93	2.89
Recreation Annual Benefit	\$4,806	\$5,004	\$5,004	\$5,004	\$5,004	\$5,004	\$5,004
Annual Recreation Charges	\$1,808	\$1,858	\$1,858	\$1,858	\$1,858	\$1,858	\$1,858
Net Benefit	\$2,998	\$3,146	\$3,146	\$3,146	\$3,146	\$3,146	\$3,146
Benefit-Cost Ratio	2.66	2.69	2.69	2.69	2.69	2.69	2.69

Table C-30 Phase IV Net Benefits and Benefit-Cost Ratios (\$1,000's)

	ND w/Staging	ND35K	MN35K
Total Alternative Benefits	\$174,817	\$173,777	\$172,454
Annual Diversion Charges	\$100,598	\$86,212	\$72,021
Net Benefit	\$74,219	\$87,565	\$100,433
Benefit-Cost Ratio	1.74	2.02	2.39
Recreation Annual Benefit	\$5,130	\$5,130	\$5,355
Annual Recreation Charges	\$1,894	\$2,015	\$1,634
Net Benefit	\$3,236	\$3,115	\$3,721
Benefit-Cost Ratio	2.71	2.55	3.28

3.9 Project Performance, Risk and Uncertainty

Given the uncertainty associated with the various hydraulic, hydrologic, and economic relationships used in the flood damage analysis, there is likewise some uncertainty regarding a project's ability to provide the mean level of flood damage reduction. The estimated benefits of each alternative are therefore presented as a distribution, rather than deterministic values. Benefit-cost ratios are presented in section 3.8.5 based on mean (also termed expected) benefits. The distributions associated with those benefits are presented in exhibit M.

This analysis provides three measures of project performance:

- 1 Annual exceedance probabilities
- 2 Long Term Risk
- 3 Conditional non-exceedance probabilities

Before discussing the three measures of project performance it is necessary to define the term "target stage," which is the water surface elevation where significant damages occur. Depending on the reach in question, the elevation where significant damages occur is defined either as:

- 1 The elevation where damages amount to 5% of the damage occurring at the 1% flood elevation, or
- 2 The top of levee elevation (if the reach has a levee), or
- 3 Other elevation relevant to study.

The three measures of project performance are discussed below:

Annual Exceedance Probabilities

This is the probability in a given year that the water surface elevation will exceed the target stage. This can also be interpreted as the probability that significant damages (defined subjectively) will occur in a given year.

Long Term Risk

This is the probability that the water surface elevation will exceed the target stage at least once in a given time period (presented for 10, 30, and 50 years). This can also be interpreted as the probability of incurring significant damages within the given period of time.

Conditional Non-Exceedance Probabilities

This is the probability that a given flood event (say the 1% flood) will not exceed the target stage. The need to define flood events (such as the 1%) using a distribution arises from uncertainties in the flow-frequency and stage-flow relationships.

The project performance measures for each Phase IV alternative (including the No-Action alternative) are presented in Exhibit M for each reach in the study area. These measures are based on the “wet” hydrology from existing conditions. Since hydrologic flows decrease throughout the period of analysis, the performance measures will overstate risk. Particularly long-term risk will be overstated. The other measures will be accurate for earlier years in the period of analysis. The project performance measures at the Fargo gage (near river mile 453) are presented in Table C-31 using the stages of 892.74 and 903.56 (gage stage of 30 and 40.82) as the target stage. These stages are important in that the gage stage of 30 is widely considered the major damage stage in the metro, and the gage stage of 40.82 is the stage of the flood of record (2009).

Below is an interpretation of the project performance analysis from Table C-31. These interpretations are intended only for the gage location, and do not apply to other reaches. For project performance at all other reaches, see Exhibit M.

Annual Exceedance Probabilities

The expected annual frequency of the 2009 gage elevation was 2.36%. With any of the three projects in place the expected annual frequency of the 2009 water surface elevation is approximately .2%.

Long Term Risk

Under existing conditions, there is a 21.22% chance the 2009 flood water surface elevation would be exceeded in a given 10 year period. With any of the three plans in place there would be approximately a 2% chance of the 2009 water surface elevation being exceeded at least once in a ten year period.

Under existing conditions, there is a 69.65% chance the 2009 water surface elevation would be exceeded in a 50 period. With any of the three plans in place there would be between a 9% and 10% chance of the 2009 water surface elevation being exceeded in a 50 year period.

Conditional Non-Exceedance Probabilities

Under existing conditions, given that a 1% event occurs, there is a 14.65% chance that the water surface elevation will not exceed the 2009 stage.

With any of the three plans in place, given that a 1% event occurs, there is approximately a 99% chance that the water surface elevation will not exceed the 2009 stage.

Under existing conditions, given that a .2% event occurs, there is a .22% chance that the water surface elevation will not exceed the 2009 stage.

With any of the three plans in place, given that a .2% event occurs, there is between a 55% and 57% chance that the water surface elevation will not exceed the 2009 stage.

Table C-31 Project Performance at Fargo Gage

Without Project - ND w/Staging - ND35k - MN35k

Plan	Target Stage	Target Stage Annual Exceedance Probability		Long-Term Risk (years)			Conditional Non-Exceedance Probability by Events					
		Median	Expected	10	30	50	10%	4%	2%	1%	0.40%	0.20%
30ft (major flood stage)												
Existing Conditions	892.74	22.56%	22.98%	92.65%	99.85%	100.00%	0.36%	0.00%	0.00%	0.00%	0.00%	0.00%
ND w/Staging	892.74	1.61%	5.66%	44.13%	76.67%	94.56%	79.95%	67.09%	49.39%	24.27%	4.20%	0.66%
ND35k	892.74	1.61%	5.66%	44.13%	76.67%	94.56%	79.95%	67.09%	49.39%	24.27%	4.20%	0.66%
MN35k	892.74	7.97%	11.15%	69.32%	94.79%	99.73%	53.66%	25.72%	11.83%	4.13%	0.53%	0.07%
40.82 (2009 stage)												
Existing Conditions	903.56	2.09%	2.36%	21.22%	44.91%	69.65%	99.96%	87.88%	47.17%	14.65%	1.67%	0.22%
ND w/Staging	903.56	0.16%	0.21%	2.04%	5.02%	9.78%	99.99%	100.00%	99.96%	98.60%	82.97%	55.25%
ND35k	903.56	0.16%	0.21%	2.04%	5.02%	9.78%	99.99%	100.00%	99.96%	98.60%	82.97%	55.25%
MN35k	903.56	0.15%	0.20%	1.94%	4.79%	9.35%	100.00%	100.00%	99.96%	98.75%	84.08%	57.04%

3.10 Risks and Uncertainties

A number of assumptions are made in the economic analysis of flood risk management studies. Resource and time constraints, sophistication of models, and technology limitations often limit the extent of analysis possible for such studies. The economic analysis for this study is likewise based on a number of assumptions, some of which are more significant than others. Significance should be determined by the level of uncertainty in the assumptions and how sensitive the results of the analysis are to that uncertainty.

The primary economic analyses to identify the NED plan were completed in Phase III of the study. In Phase IV, the study team continued to refine the hydrologic and hydraulic models solely to determine the upstream and downstream impacts of the diversion plans. In coordination with the Corps vertical team, no efforts were made to revisit the determination of the NED plan. The Phase III analyses adequately serve the required purpose of “reasonably maximizing” the NED benefits.

The following assumptions are sources of uncertainty for the NED analysis presented in this appendix (in no particular order).

3.10.1 Emergency Measures Sensitivity

The cities of Fargo and Moorhead have had success in fighting high flows on the Red River of the North in every major flood from 1997 to 2011. A number of variables have contributed to the success of the flood fight. These include warning time to prepare emergency measures, accuracy (relative) of crest predictions, adequate resources and volunteer labor, and timing of spring warm-up. Lastly the structural integrity of earthen levees, sandbags, and other flood barriers has been sound enough to avoid significant damages. Emergency measures, however, are not 100% effective, despite the fact that Fargo and Moorhead have always had success in the past. For the purposes of plan formulation and evaluation, it is assumed that the flood fight will always fail in the future. Under this scenario, expected annual damage and project benefits would be higher than if any degree of reliability were credited to the flood fight. As a reality check, a sensitivity analysis was conducted to determine the level of flood fight reliability that would make the NED plan, FCP, and LPP, and ND35k plan not feasible. EEAB for each plan was evaluated with emergency levees in place. There is a general consensus that the cities of Fargo and Moorhead would be unable to flood fight an event larger than the 2009 flood. Therefore, the 2009 flood elevations were used to determine the maximum height of emergency levees for this analysis. Table C-32 presents the results of this analysis. With full credit to emergency measures, all plans are still feasible.

Table C-32 Flood Fight Sensitivity EEAB (\$1,000's)

Plan	EEAB needed		
	EEAB no Credit	EEAB Full Credit	for BCR >1
ND w/Staging	\$174,817	\$157,432	\$100,932
ND-E-35k	\$173,777	\$156,392	\$86,259
MN-S-40k*	\$186,956	\$170,044	\$70,301
MN-S-35k	\$172,454	\$155,132	\$72,021

Cost are from Phase III - normally would be higher than MN35k costs

3.10.2 Difference in Frequency Curves

This issue is mentioned in section 3.4. The analysis of EAD and EEAD for metro area reaches on the RRN utilizes a Log-Pearson Type III (LPT3) flow-frequency curve. This approach better defines the uncertainty in the flow-frequency curve. The result is a non-centric distribution of flows, which tends to result in higher EAD than if another form of frequency analysis were used. The analysis of EAD for reaches along the tributaries and the RRN outside the metro utilizes an elevation-frequency curve, which results in a centric distribution of elevations. This approach does not define uncertainty about the elevations as well as the LPT3 curve. A comparison of the two approaches for the same reach showed that the theoretic maximum flood elevation for the .2% event was 1-2 ft higher with a LPT3 approach than with an elevation-frequency approach. The practical implication of this is that EAD and EEAD (and therefore EAB, EEAB, and induced damages) will look understated in elevation-frequency reaches when compared to LPT3 reaches. The potential risk is that EEAB on the tributary reaches in the metro will be understated for North Dakota diversion, and that induced risk upstream and downstream of the metro is understated for all diversions. This has the potential to impact the comparison of alternatives. The vertical team is confident that this issue would not significantly affect the identification of an NED plan and a selected plan.

3.10.3 Flow-Frequency used for with-project Analysis

The analysis of EEAD and project performance for without-project conditions uses LPT3 curves and elevation curves, each with a high degree of uncertainty in flows and elevations. The analysis if with-project conditions EEAD and project performance employs the same degree of uncertainty in flows and elevations.

Each diversion alternative has gated control structures at their upstream end, which allows for greater control of flows through the metro (and less uncertainty in flows and elevations). Control structures would reduce the variability in flow-frequency for the metro area; but that variability would be transferred upstream or downstream (excess flows

would either be stored or pass down the diversion channel). The LPP has additional storage capacity, which would likely augment these effects. This would not impact the without project EEAD, but would tend to overstate EEAD with-project in the metro and understate EEAD in downstream reaches. The project performance for with-project conditions would likewise overstate risk in the metro area and understate it upstream or downstream. This has the potential to impact the comparison of alternatives. The vertical team is confident that this issue would not significantly affect the identification of an NED plan and a selected plan.

3.10.4 Use of Steady Flow Hydraulic Model for Metro Area

This issue is mentioned in section 3.4.3. Two hydraulic models were developed in Phases III and IV, a steady state flow model and an unsteady state flow model. The unsteady flow model utilizes river cross sections for in channel flows as well as storage cells for breakout flows. The steady state flow model uses river cross sections but not storage cells. This model uses the same hydrology as the unsteady state flow model. The steady flow model is used for evaluation of EEAD and EEAB in the metro area along the RRN. Since the steady flow model contains all flows within the river cross sections, while the unsteady flow model allows flows into storage cells, the flow-elevations tend to be higher in the steady flow model at each cross section relative to the unsteady model. Using the steady flow model tends to overstate EEAD in river cross section and understate it in storage cells. Overall, the steady flow model likely overstates EEAD and EEAB. This has the potential to impact the comparison of alternatives. The vertical team is confident that this issue would not significantly affect the identification of an NED plan and a selected plan.

3.10.5 ND35K EEAB to Estimate LPP EEAB

The North Dakota with Staging alternative was developed in Phase IV and selected as the Locally Preferred Plan. Concurrently, all hydraulic modeling was done using an unsteady state model. The economic analysis for the Metro area was not revisited in Phase IV, since implementing the unsteady flow model would have required significant time and resources, and the NED analysis, completed in Phase III, was unlikely to change substantially. As a result, the revised LPP was developed in order to match the water surface elevations of the ND35K plan. This made the level of benefits provided by each plan comparable and warranted using the ND35K benefits as a proxy for the LPP benefits (as mentioned in section 3.7.1). There are uncertainties in this approach that require consideration. The LPP functions differently than the ND35K plan, in that the LPP provides benefits from the diversion channel as well as staging and storage features. This leads to a different operating plan with potentially less stage uncertainty in the protected area and more stage uncertainty downstream and upstream. It is possible that additional economic modeling would result in different EEAB for the LPP. It is unlikely that this would impact identification of the LPP.

3.10.6 Use of Project Performance Metrics from Analysis Year 2019

All project performance metrics are given from the “wet” period hydrology (the analysis year 2019). As a result long term flood risk tends to be overstated. Annual exceedance and conditional-non exceedance probabilities are accurate for the base year, but tend to

over state risk for later years. Consideration was given to averaging the performance metrics of all 3 analysis years, however it was concluded that the averaged metrics would be no easier to interpret than the base year metrics. The metrics displayed in this report are presented with the caveat that they are valid only for the base year, and are overstated for later years.

3.10.7 Use of Single Analysis Year for Upstream and Downstream

The upstream and downstream flood risk analysis utilized “wet” period hydrology from the base year. A truer analysis would incorporate future year hydrology to account for the non-stationarity of flow-frequency in the RRN. The use of base year hydrology tends to overstate EEAD and induced damage, since the flow-frequency curve tends to shift down over time. It is unlikely that this would have an appreciable effect on the damage estimates.

4.0 Regional Economic Development Account

NOTE: This analysis has not been updated for the Phase IV alternatives. The FY 10 discount rate of 4-3/8% is used for discounting, compounding, and annualization. Dollar figures are presented in FY 10 price levels.

4.1 Introduction

4.1.1 Project Overview

This report discusses effects on the regional economy of the proposed Fargo-Moorhead Flood Diversion Project. It provides the Regional Economic Development (RED) account as outlined in the United States Army Corps of Engineers (USACE) *Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies* (a.k.a. Principles and Guidelines or P&G).

The positive effects of the project on the region's income are equal to the sum of the National Economic Development (NED) benefits that accrue to the region, plus transfer of income from outside the region. Income transfers to the region as a result of the project include income from implementation outlays, transfers of basic economic activity, and indirect and induced effects. In each case, income transfers refer to new income within the region rather than to increases in total expenditures. Similarly local costs and cost shares within the region are captured in determining the net regional economic impact. Indirect and induced impacts are the effects of the injection of money into the local economy. These effects are not the expenditures themselves, but the additional economic activity stimulated by the expenditures. For example, a direct expenditure may include the salaries paid to construction crews working on the project. An example of indirect expenditures would be the hotel expenses of construction crews staying in the region during construction. An example of an induced expenditure would be the changes in spending patterns by local businesses or individuals whose income is increased as a result of direct expenditures. Indirect and induced impacts are estimated using multipliers obtained from the regional Input-Output model discussed in section 4.2.3.

Although a number of flood risk management alternatives are being considered in the NED analysis, the RED analysis undertaken for this report only considers the most economically attractive With-Project alternatives within North Dakota (North Dakota East Diversion 35k cfs) and within Minnesota (Minnesota Short 35k cfs and Minnesota Short 20k cfs). These three alternatives are compared to the project baseline (Without-Project conditions) of continued flooding and flood fighting throughout the Fargo-Moorhead study region.

4.1.2 GFMEDC Business Survey

Following the successful flood fight in Fargo-Moorhead in 2009, the Greater Fargo Moorhead Economic Development Corporation (GFMEDC) completed a flood protection questionnaire with major local businesses to gauge local reaction. Businesses were asked how their companies would be affected had the region been devastated with severe flooding. The results of the survey revealed anxiety among local business owners, and demonstrated that companies would leave the region in the event of a failed flood fight. In some cases, the loss of business to the Fargo-Moorhead MSA would be significant to the U.S. economy in that businesses are increasingly moving their operations overseas.

The national impact of a hypothetical manufacturing industry leaving the Fargo-Moorhead MSA is explored in Section 4.3.4.

4.2 **Approach and Assumptions**

4.2.1 Approach

The approach for this study was to assess the regional economic impacts associated with three aspects of the With-Project alternatives being considered:

- Construction costs (Section 4.3.1)
- Avoided flood damages (including avoided losses in business activity, avoided direct losses in regional product, and losses in indirect/induced regional product) (Section 4.3.2)
- Avoided loss in business confidence (without a permanent solution, the Fargo-Moorhead study region experiences reduced economic growth) (Section 4.3.3)

Furthermore, the study investigated the regional and national effects of a hypothetical local business relocating internationally if the Fargo/Moorhead Flood Diversion project did not proceed. For more information see Section 4.3.4.

The indirect/induced output and employment and tax impacts associated with the Fargo-Moorhead Flood Diversion project were estimated by DataSource as discussed below.

All costs and benefits are presented as annual equivalent values. Annual equivalent values are calculated over 50 years unless stated otherwise.

4.2.2 Period of Analysis

The regional costs and benefits associated with the Fargo/Moorhead Flood Diversion project alternatives occur at different times. The regional economic analysis has been undertaken relative to the base year which is the year construction is finalized. For this reason, construction costs are appreciated (Minnesota alternatives – 6 years, North Dakota - 8 years) by adding interest during construction to the base cost estimate. Likewise, costs associated with loss of business confidence, which is assumed for the Without-Project alternative, will occur with construction costs prior to the base year. Therefore these costs are also appreciated to the base year.

4.2.3 Regional Economic Impact Analysis

Various approaches have historically been used to assess the effect a change in production or expenditure will have on a region's economy. The most common approach has arguably been the use of input-output (I-O) models. The use of I-O models in economic impact analyses has increased dramatically with the advent of ready-made regional models. Ready-made models reduce both the time and cost of using I-O models for economic input assessment. In the United States, the three most widely used ready-made models are the IMPLAN⁴ model initially produced by the U.S. Department of Agriculture Forest Service, the REMI model produced by Regional Economic Models Inc., and the RIMS II model developed by the U.S. Department of Commerce Bureau of Economic Analysis (BEA).

An I-O model uses a matrix representation of a region's economy to predict the effect of changes in one industry on others and by consumers, government, and foreign suppliers on the economy. It is a static, linear model of all purchases and sales between sectors of an economy. While I-O models are useful in providing ball-park estimates of very short-run responses to changes in production/expenditures, their key limitations are linearity, absence of behavioral considerations, absence of markets and prices, and lack of formal constraints (Rose 2006).

The limitations of I-O models are also the key advantages of Computable General Equilibrium (CGE) modeling. A CGE model is a non-linear model of individual behavioral response to price signals, subject to labor, capital, and natural resources constraints (Shoven and Whalley 1992 cited in Rose 2006). These advantages come with increased modeling complexity, much greater data needs, and time resources for operation. Therefore, while the use of CGE modeling is increasing, resource and data constraints make its use impractical at the regional level.

For this project, RIMS II regional multipliers are used to assess the regional economic impacts associated with the Fargo-Moorhead Flood Diversion Project. BEA's RIMS II multipliers provide a cost-effective way to estimate the economic impacts of changes in a regional economy, but like all economic impact models, RIMS II estimates of impacts are approximate order-of-magnitude estimates. However, empirical research has shown that RIMS II yields multipliers that are not substantially different in magnitude from those generated by regional I-O models based on relatively expensive surveys. The difference between RIMS II and survey-based multipliers is often only between 5 and 10 percent (BEA 2009).

In 2002, the GFMEDC obtained RIMS II multipliers for the local region and then adjusted the multipliers to reflect local conditions. The adjusted multipliers were then independently reviewed by Dr. Larry Leistritz at North Dakota State University, who concluded that if anything, their use would potentially underestimate regional economic impacts.

4.2.4 Assumptions

4.2.4.1 Economic Assumptions

Three types of regional economic multipliers were used to assess RED impacts: an output multiplier, an employment multiplier, and an earnings multiplier.

An output multiplier was used to estimate the indirect and induced output or revenues created and supported in businesses in the area. An employment multiplier was used to estimate the number of indirect and induced jobs created and supported in the State. An earnings multiplier

⁴ The current IMPLAN I-O database and model is maintained and sold by MIG Inc. (Minnesota IMPLAN Group)

was used to estimate the amount of salaries to be paid to workers in these new indirect and induced jobs.

The multipliers show the estimated indirect and induced revenues of other companies in the area for every dollar of direct revenues generated by companies working on the project. An employment multiplier shows the number of indirect and induced jobs created for every direct job at the facility and the amount of salaries paid to these workers for every dollar paid to a direct worker on the project. The indirect and induced multipliers shown in Table C-33 were used in this analysis.

Table C-33 Indirect and Induced Multipliers used in the Analysis

	Construction	Operations	Avoided Flood Damages	Loss of business confidence
Output multiplier	0.4009	0.3790	0.3291	N/A
Employment multiplier	0.3363	0.1975	10.44*	10.44*
Earnings multiplier	0.3157	0.3089	0.3646	0.3646

Source: DataSource

*The number of jobs created in the regional economy from an additional \$1 million of output.

4.2.4.2 Construction and Operations and Maintenance Costs

This section outlines the assumptions used to determine the RED impact associated with construction costs and annual operations and maintenance costs. The three With-Project options assessed are the North Dakota East 35k cfs, Minnesota Short 35k cfs and Minnesota Short 20k cfs channel diversion alternatives (Table C-34).

Table C-34 RED Project Costs for ND East 35k cfs, MN Short 35k cfs and MN Short 20k cfs (\$1,000's)

	North Dakota East 35k cfs	Minnesota 35k cfs	Minnesota 20k cfs
Length of project, in years	8	6	6
Total construction costs	\$1,294,707	\$1,142,545	\$870,513
Scheduled construction costs per year	\$161,838	\$190,424	\$145,085
Total labor costs	\$517,883	\$457,018	\$348,205
Construction labor costs per year	\$64,735	\$76,170	\$58,034
Estimated construction salaries per year (about \$20 an hour)	\$41.6	\$41.6	\$41.6
Annual Operation & Maintenance Costs	\$3,011	\$2,861	\$2,187

Source: USACE and Impact DataSource estimates

It is assumed that total construction costs would be injected into the local economy producing indirect and induced economic output.

4.2.4.3 Avoided Flood Damages

This section outlines the assumptions used to determine the RED impacts associated with avoided flood damages. Data on the expected annual benefits (avoided flood damages) for the North Dakota East 35k cfs Minnesota Short 35k cfs and Minnesota Short 20k cfs alternatives are shown in Table C-35, Table C-36 RED MN35 and Table C-37 respectively.

Table C-35 RED ND35 Expected Annual Benefit (\$1,000's) – North Dakota East Diversion 35k cfs

Damage Classification	Fargo North	Fargo South	West Fargo	Moorhead	Cass County	Other	Total
Agricultural	\$203	\$1	\$3	\$17	\$25	---	\$249
Apartment	\$2,243	\$1,877	\$230	\$495	\$0	---	\$4,845
College	\$788	\$3	\$0	\$19	\$0	---	\$811
Commercial	\$16,300	\$6,733	\$1,512	\$384	\$99	---	\$25,028
Public	\$1,324	\$1,376	\$19	\$81	\$142	---	\$2,942
Residential	\$7,994	\$10,764	\$3,568	\$3,102	\$3,830	---	\$29,258
Emergency	---	---	---	---	---	\$4,223	\$4,223
						Total	\$67,355

Source: USACE February 2010

Table C-36 RED MN35 Expected Annual Benefit (\$1,000's) – Minnesota Short Diversion 35k cfs

Damage Classification	Fargo North	Fargo South	West Fargo	Moorhead	Cass County	Other	Total
Agricultural	\$204	\$1	\$3	\$10	\$8	---	\$225
Apartment	\$2,247	\$1,887	\$202	\$497	\$0	---	\$4,832
College	\$792	\$3	\$0	\$20	\$0	---	\$814
Commercial	\$16,326	\$6,769	\$1,528	\$380	\$66	---	\$25,069
Public	\$1,326	\$1,379	\$19	\$80	\$86	---	\$2,890
Residential	\$7,978	\$10,655	\$2,483	\$3,068	\$1,549	---	\$25,733
Emergency	---	---	---	---	---	\$4,232	\$4,232
						Total	\$63,795

Source: USACE February 2010

**Table C-37 RED MN20 Expected Annual Benefit (\$1,000's) – Minnesota Short Diversion
20k cfs**

Damage Classification	Fargo North	Fargo South	West Fargo	Moorhead	Cass County	Emergency	Total
Agricultural	\$170	\$1	\$2	\$9	\$7	---	\$189
Apartment	\$1,897	\$1,603	\$169	\$426	\$0	---	\$4,095
College	\$665	\$2	\$0	\$17	\$0	---	\$684
Commercial	\$13,748	\$5,737	\$1,278	\$323	\$57	---	\$21,144
Public	\$1,134	\$1,197	\$16	\$67	\$77	---	\$2,490
Residential	\$6,779	\$9,150	\$2,080	\$2,614	\$1,375	---	\$21,997
Emergency	---	---	---	---	---	\$3,792	\$3,792
Total							\$54,390

Source: USACE February 2010

The data in Table C-35, Table C-36, and Table C-37 are expected annual benefits that were calculated by subtracting residual damages (with flood diversion) from the estimate of annual damages under Without-Project conditions. For more information on Without-Project damages and residual damages, refer to Exhibit A.

To assess the full RED impacts associated with these expected annual benefits (NED benefits), the contribution of structural, contents, and other damages to total damages had to be considered. The split between structural, contents, and other damages is also summarized in Exhibit A.

Depreciated structural values were used to calculate NED benefits. However, it is appropriate to estimate regional impacts using total building replacement values which reflect the market cost to replace damaged property. For example, it is not practical to replace 75% of a flood damaged structure, but rather replace it completely which will mean the structure will be in better condition than when it was damaged. Therefore depreciated structural values were increased by the assumed depreciation values shown in Table C-38.

Table C-38 Assumed Structural Depreciation Values

	Fargo North	Fargo South	West Fargo	Moorhead	Cass County
Agricultural	12%	4%	9%	N/A	8%
Apartment	9%	4%	12%	11%	8%
College	13%	4%	N/A	13%	9%
Commercial	10%	4%	12%	10%	9%
Public	11%	3%	6%	10%	7%
Residential	16%	15%	16%	16%	16%

Source: URS (2009), Marshall and Swift (2009a, 2009b)

Assumptions were also made for the proportion of affected properties with flood insurance and/or access to FEMA Public Assistance in the event of a declared disaster (Table C-39).

Table C-39 Assumed Flood Insurance and/or Access to Public Assistance

Damage Classification	Proportion	Notes
Agricultural	5%	Estimated by the authors
Apartment	20%	Based on FEMA flood insurance policies for the study region
College	50%	Assumed 50% publicly owned with access to Public Assistance
Commercial	10%	Estimated by consultants
Public	100%	Access to Public Assistance
Residential	20%	Based on FEMA flood insurance policies for the study region (Ashford 2009)

Where properties have access to flood insurance and/or Public Assistance, 20 percent of costs were assumed to be provided locally, with the remainder funded from outside the region. Using these assumptions and the damages shown in Exhibit A, the weighted average of 85 percent of damages are estimated to be paid for from within the Fargo-Moorhead region.

While flood damages result in a direct loss of gross domestic product for the region, some industries, for example the construction industry, would benefit. In the aftermath of a flood event, contractors would be required to rebuild homes, as would companies replacing damaged building contents and providers of temporary accommodation (although some businesses would be affected by flood damages themselves and be unable to meet demand). The following assumptions were made to reflect the short-term effect a flood would have in stimulating the local economy, and are based on considerations of the ability of the local economy to meet demand – both under normal circumstances and after a flood.

Structural Damages

- One-third of building contractors are from within the local region
- Indirect/induced effects are captured for all structural damages (both local and other contractors)

Contents Damages

- 75 percent of damaged contents are replaced locally
- Indirect/induced effects are captured for 75 percent of contents damages

Other Damages

- 100 percent of other damages are incurred locally

4.2.4.4 Avoided Loss of Business Income

An assessment was made of the avoided loss of business income for non-residential structures associated with reduced flooding. HEC-FDA Structure Detail Out files for Without-Project conditions were combined with additional data collected during a structure inventory performed

in the Fargo-Moorhead area in 2009.⁵ The structure inventory data provided additional details about each nonresidential structure including the type of business as assigned by a Marshall and Swift occupancy code, and total square footage. The Marshall and Swift Occupancy Codes are provided as Exhibit B.

The HEC-FDA output files provided data on the depth of flooding in each structure for eight flood frequencies (2-, 5-, 10-, 20-, 50-, 100-, 200-, and 500-year flood events). Existing levees were accounted for. The depth of flooding for each flood event was used to determine the days of business interruption using a depth-damage function (DDF) provided by FEMA. The DDF relates depth of flooding to structural damage and subsequently, business interruption or days of “loss of function.” The DDF used is shown in Table C-40.

Table C-40 Depth-Damage Function: Depth of Flooding versus Business Interruption

Depth of Flooding Relative to Structure FFE* (feet)	Business Interruption (days)
-2	0
-1	0
0	0
1	45
2	90
3	135
4	180
5	225
6	270
7	315
8	360
9	405
10+	450

Source: FEMA BCA Tool (v4.5.5)⁶

**FFE is the 1st finished floor elevation. All flood depths are relative to the elevation of the FFE.*

Based on assigned Marshall and Swift occupancy codes, each non-residential structure was assigned one of five classifications for average annual business income, which in turn were assigned a dollar per square foot amount. The rating for each Marshall and Swift occupancy code is provided in Exhibit B. Financial metrics, including income, costs, profit, and rent, are often expressed per square foot, to provide a comparable metric that is not affected by a building’s footprint. Furthermore, companies such as BizMiner produce a “retail sales per square foot” report for almost 150,000 commercial businesses. In assessing loss of business income for the Fargo-Moorhead region, data on sales per square foot was obtained for select

⁵ Complete details of the structure inventory are described in the URS report, “Final Project Report: Fargo-Moorhead Nonresidential and Residential Structure Inventory and Nonresidential Surveys”, previously provided to the St. Paul District.

⁶ The FEMA BCA Tool Kit, Version 4.5.5 for the Hazard Mitigation Assistance program can be obtained from <http://www.bchelpline.com/>

businesses in North Dakota from the 2002 U.S Economic Census.⁷ Inflated to 2008 dollars, sales ranged from \$550 to \$250 per square foot.

The assumed annual business income per square foot that was developed based on census data and other publicly available sales data is shown in Table C-41 for each income category.

Table C-41 Assumed Annual Business Income by Income Category

Category	Definition	Annual Income (\$/sf)
N	Negligible	\$0.00
VL	Very Low	\$50.00
L	Low	\$150.00
M	Moderate	\$400.00
H	High	\$650.00

Source: U.S. Census 2002

The average daily income was multiplied by the days of business interruption for each flood event to calculate the loss of business income. The resulting frequency damage curve was then integrated to calculate the annual loss of business income for all flood frequencies (Table C-42)

Table C-42 Estimated Annual Loss of Business Income by Building Classification (\$1,000's)

	Fargo North	Fargo South	West Fargo	Moorhead	Cass County	Total
Agricultural	\$0	\$0	\$0	\$0	\$0	\$0
Apartment	\$0	\$0	\$0	\$0	\$0	\$0
College	\$0	\$0	\$0	\$0	\$0	\$0
Commercial	\$52,893	\$7,439	\$3,026	\$516	\$334	\$64,207
Public	\$1,576	\$0	\$9	\$0	\$16	\$1,602
Residential	\$0	\$0	\$0	\$0	\$0	\$0
Total	\$54,468	\$7,439	\$3,036	\$516	\$350	\$65,810

The total estimated annual loss of business income is equal to \$65.8 million. In Section 4.3, the indirect output, employment, and state/local tax implications for this loss of income are calculated. The loss of business income after mitigation is assumed to be negligible with all three With-Project alternatives. Therefore, the estimated annual loss of business income shown in Table C-42 is also the expected annual benefit for all three With-Project alternatives.

4.2.4.5 Loss of Business Confidence

This section outlines the assumptions used to determine the RED impact for a loss of business confidence resulting from frequent flooding in the Fargo-Moorhead MSA. The completion of a

⁷ U.S. Census, Sector 44: Retail Trade: Subject Series - Misc Subjects: Floor Space by Selected Kind of Business for the United States and States: 2002.

flood diversion project in the Fargo-Moorhead MSA would provide a level of certainty for businesses and encourage general economic growth in the region. By looking at the difference between projected growth with and without the flood diversion project, the loss of business confidence in the region can be determined.

The loss of business confidence is calculated by analyzing the difference in the fiscal impacts associated with the gross domestic product for the Fargo MSA under two scenarios:

- Without flood diversion project
- With flood diversion project

A conservative and a moderate growth rate in regional output for the regional economy is assumed under each of these scenarios. The growth rates do not reflect actual flooding, but rather the perceived risk of flooding under the Without- and With-Project scenarios.

Although the NED analysis assumes that the same level of development would occur with or without a project, in reality some additional demand for new commercial structures would occur. The RED analysis is sensitive to changes in business activity; however it is difficult to predict how changes in business activity will affect demand for new buildings. While additional business activity would occur if a flood risk management project were completed, that activity may or may not occur in the floodplain, and may or may not significantly impact development. Therefore, it is a critical assumption for the RED analysis that the level of economic activity would be affected by a project; however it is not an important factor in the analysis of flood damage reduction for the NED account.

Without-Project Alternative

If no flood diversion project is completed in the region, businesses may leave the Fargo-Moorhead area, be reluctant to expand, or refuse to locate in the area due to concerns over potential flood damages. Additionally, individuals will be reluctant to remain or move to the Fargo-Moorhead area, further dampening economic growth in the region.

The analysis projects two levels of growth for the Without-Project alternative (Table C-43).

- *Conservative Case: 1.29 percent MSA GDP growth*

For the conservative case, the growth rate for the Without-Project alternative is assumed is equal to the first quartile annual average growth rate from 2001–2008 for all MSAs in the United States.

- *Moderate Case: 2.18 percent MSA GDP growth*

For the moderate case, the growth rate for the Without-Project alternative is assumed is equal to the median annual average growth rate from 2001–2008 for all MSAs in the United States.

With-Project Alternative

If the flood diversion project is completed in the region, businesses would be more confident and more likely to remain and expand in the area. The recent economic growth in the region may be spurred on further as other firms choose to locate in the Fargo-Moorhead area.

- *Conservative Case: 3.09 percent MSA GDP growth*

For the conservative case, the growth rate for the With-Project alternative is assumed is equal to the third quartile annual average growth rate from 2001–2008 for all MSAs in the United States.

- *Moderate Case: 4.11 percent MSA GDP growth*

For the moderate case, when the growth rate for the With-Project alternative is assumed is equal to the annual average growth rate from 2001–2008 for the Fargo MSA. This growth rate is in the 89th percentile for all MSAs during this period. Recently, the Fargo MSA has seen even greater growth. The annual average growth rate for the Fargo MSA from 2006–2008 is 5.1 percent. In the absence of other factors, the Fargo MSA would not be expected to maintain such a high growth rate going forward.

Table C-43 Fargo MSA Assumed Real Growth Rates

	Without-Project		With-Project	
	Conservative	Moderate	Conservative	Moderate
	<i>Case 1</i>	<i>Case 2</i>	<i>Case 3</i>	<i>Case 4</i>
Annual Growth Rate	1.29%	2.18%	3.09%	4.11%

4.3 RED Impacts

4.3.1 Construction and Operations and Maintenance

4.3.1.1 Economic Output/Increase in Gross Regional Product during Construction

The project would provide the following direct and indirect and induced economic output/increases in gross regional product during construction (Table C-44).

Table C-44 Economic Output/Increase in Gross Regional Product during Construction (\$1,000's)

	North Dakota East 35k cfs			Minnesota 35k cfs			Minnesota 20k cfs		
	Direct Const. Output	Indirect and Induced Output	Total Economic Output	Direct Const. Output	Indirect and Induced Output	Total Economic Output	Direct Const. Output	Indirect and Induced Output	Total Economic Output
Year 1	\$161,838	\$64,881	\$226,719	\$190,424	\$76,341	\$266,765	\$145,086	\$58,165	\$203,250
Year 2	\$161,838	\$64,881	\$226,719	\$190,424	\$76,341	\$266,765	\$145,086	\$58,165	\$203,250
Year 3	\$161,838	\$64,881	\$226,719	\$190,424	\$76,341	\$266,765	\$145,086	\$58,165	\$203,250
Year 4	\$161,838	\$64,881	\$226,719	\$190,424	\$76,341	\$266,765	\$145,086	\$58,165	\$203,250
Year 5	\$161,838	\$64,881	\$226,719	\$190,424	\$76,341	\$266,765	\$145,086	\$58,165	\$203,250
Year 6	\$161,838	\$64,881	\$226,719	\$190,424	\$76,341	\$266,765	\$145,086	\$58,165	\$203,250
Year 7	\$161,838	\$64,881	\$226,719						
Year 8	\$161,838	\$64,881	\$226,719						
Total	\$1,294,707	\$519,048	\$1,813,755	\$1,142,545	\$458,046	\$1,600,591	\$870,513	\$348,989	\$1,219,502
An. Eqv.	\$64,188	\$25,733	\$89,921	\$56,644	\$22,709	\$79,353	\$43,158	\$17,302	\$60,459

Source: DataSource

* Annual equivalent values were calculated using a discount rate of 0.04375 over 50 years.

The direct cost impact to the Fargo-Moorhead region is the estimated 20 percent of construction costs that would be met locally. This is Fargo-Moorhead's anticipated contribution to the non-Federal share of project costs (Federal/Non-Federal cost share rate of 65/35). However, the regional benefit associated with construction is the indirect and induced economic output that would be produced for an assumed 100 percent of the construction cost. The net RED benefits associated with construction are shown in Table C-45.

Table C-45 Regional Benefits and Costs during Construction (\$1,000's)

	North Dakota East 35k cfs			Minnesota 35k cfs			Minnesota 20k cfs		
	Direct Regional Cost	Indirect and Induced Benefit	Total Economic Benefit	Direct Regional Cost	Indirect and Induced Benefit	Total Economic Benefit	Direct Regional Cost	Indirect and Induced Benefit	Total Economic Benefit
Year 1	\$32,368	\$64,881	\$32,513	\$38,085	\$76,341	\$38,256	\$29,017	\$58,165	\$29,148
Year 2	\$32,368	\$64,881	\$32,513	\$38,085	\$76,341	\$38,256	\$29,017	\$58,165	\$29,148
Year 3	\$32,368	\$64,881	\$32,513	\$38,085	\$76,341	\$38,256	\$29,017	\$58,165	\$29,148
Year 4	\$32,368	\$64,881	\$32,513	\$38,085	\$76,341	\$38,256	\$29,017	\$58,165	\$29,148
Year 5	\$32,368	\$64,881	\$32,513	\$38,085	\$76,341	\$38,256	\$29,017	\$58,165	\$29,148
Year 6	\$32,368	\$64,881	\$32,513	\$38,085	\$76,341	\$38,256	\$29,017	\$58,165	\$29,148
Year 7	\$32,368	\$64,881	\$32,513						
Year 8	\$32,368	\$64,881	\$32,513						
Total	\$258,941	\$519,048	\$260,107	\$228,509	\$458,046	\$229,537	\$174,103	\$348,989	\$174,886
AnEqv*	\$12,838	\$25,733	\$12,895	\$11,329	\$22,709	\$11,380	\$8,632	\$17,302	\$8,670

Source: DataSource

* Annual equivalent values were calculated using a discount rate of 0.04375 over 50 years.

Given the assumed labor costs and that the annual average salary for workers is \$41,600, the project would result in 1,556, 1,831 and 1,395 jobs annually for the North Dakota East 35k cfs Minnesota Short 35k cfs and Minnesota Short 20k cfs alternatives, respectively. Indirect and induced employment would add an additional 523, 613 and 469 jobs for the North Dakota East 35k cfs Minnesota Short 35k cfs and Minnesota Short 20k cfs alternatives, respectively.

During construction, the project would generate the tax revenues shown in Table C-46 for the States and local taxing districts. The assumptions used to develop these estimates are provided in Exhibit C.

Table C-46 Annual Equivalent State and Local Tax Revenues during Construction (\$1000)

	North Dakota East 35k cfs	Minnesota Short 35k cfs	Minnesota Short 20k cfs
States of North Dakota and Minnesota	\$3,420	\$3,018	\$2,300
Local taxing districts	\$695	\$640	\$488
Total	\$4,115	\$3,659	\$2,788

Source: DataSource

* Annual equivalent values were calculated using a discount rate of 0.04375 over 50 years.

4.3.1.2 Economic Output/Increase in Gross Regional Product from Operations and Maintenance

The project would provide the following direct, indirect and induced economic output/increase in gross regional product associated with operations and maintenance:

Table C-47 Annual Economic Output for Operations and Maintenance (\$1,000's)

	Direct Operations Output	Indirect and Induced Output	Total Output
North Dakota East 35k cfs	\$3,011	\$1,141	\$4,152
Minnesota Short 35k cfs	\$2,861	\$1,084	\$3,945
Minnesota Short 20k cfs	\$2,187	\$829	\$3,016

Source: DataSource

The direct cost impact to the Fargo-Moorhead region is the 100 percent of operations and maintenance costs that would be met locally. However, the regional benefit associated with operations and maintenance is the indirect and induced economic output that would be produced. The net RED benefit/cost associated with operations and maintenance is shown in Table C-48.

Table C-48 Regional Benefits and Costs during Operations and Maintenance (\$1,000's)

	Direct Operations Output (Cost)	Indirect and Induced Output (Benefit)	Total Output Net Benefit
North Dakota East 35k cfs	\$3,011	\$1,141	(\$1,870)
Minnesota Short 35k cfs	\$2,861	\$1,084	(\$1,777)
Minnesota Short 20k cfs	\$2,187	\$829	(\$1,358)

Source: DataSource

Assuming that 30 percent of these costs are for salaries and the annual average salary for workers is \$41,600, the project would result in 22, 21 and 16 direct jobs for the North Dakota East 35k, Minnesota Short 35k cfs and Minnesota Short 20k cfs alternatives, respectively. Indirect and induced employment will add an additional 4.4, 4.1, and 3.2 jobs for the North Dakota East 35k, Minnesota Short 35k cfs and Minnesota Short 20k cfs alternatives, respectively. Operations and maintenance would generate the following total revenues for the States and local taxing districts (Table C-49). The assumptions used to develop these estimates for tax revenues are provided in Exhibit D.

**Table C-49 Annual State and Local Tax Revenues due to Operations and Maintenance
(\$1,000's)**

	North Dakota East 35k cfs	Minnesota Short 35k cfs	Minnesota Short 20k cfs
States of North Dakota and Minnesota	\$74	\$71	\$54
Local taxing districts	\$16	\$15	\$11
Total	\$90	\$86	\$65

Source: DataSource

4.3.2 Avoided Flood Damages

The avoided flood damages presented in this section are the regional impacts associated with NED impacts and loss of business income. The assumptions behind these damages are outlined in Sections 4.2.4.3 and 4.2.4.4, respectively.

4.3.2.1 Regional Impacts Associated with NED Impacts

As described in Section 4.2.4.3 and shown in Exhibit A, the total estimated annual NED impacts are \$77.0 million for Without Project conditions, and \$9.7 million, \$13.3 and \$22.7 million for the North Dakota East 35k cfs, Minnesota Short 35k cfs and Minnesota Short 20k cfs alternatives, respectively.

These total NED damages were adjusted to increase depreciated structural damages to full replacement values and to reflect local expenditures only. Local expenditures were estimated at 85% of total annual flood damages. The resulting damages are shown in Table C-50.

Table C-50 Annual Flood Damages (\$1,000's)

	Without-Project Conditions	With-Project		
		North Dakota East 35k cfs	Minnesota Short 35k cfs	Minnesota Short 20k cfs
Structural Damages*	\$28,662	\$3,723	\$5,389	\$8,874
Content Damages	\$29,827	\$3,868	\$5,024	\$8,772
Other Damages	\$3,188	\$417	\$629	\$1,020
Total	\$61,676	\$8,007	\$11,042	\$18,666

* Due to depreciation, structural damages were increased to reflect the full cost for building replacement.

The annual flood damages would spur construction and indirect effects associated with repairing and replacing damaged structures and contents (Table C-51). The effect of reconstruction would be an increase in economic output. The construction industry would directly benefit from the need to increase damaged building infrastructure. Only 33 percent of construction is assumed to be undertaken by local firms.

**Table C-51 Increase in Output in the Fargo-Moorhead Region Due to Reconstruction
(\$1,000's)**

	Without-Project Conditions	With-Project		
		North Dakota East 35k cfs	Minnesota Short 35k cfs	Minnesota Short 20k cfs
Direct Output from Repair of Flood Damage				
Structural (33% of structural flood damages)	\$11,240	\$1,460	\$2,113	\$3,480
Indirect and Induced Output from Repair of Flood Damage				
Structural (100% of indirect output calculated from annual structural flood damages)	\$11,097	\$1,441	\$2,087	\$3,436
Contents (75% of indirect output calculated from annual contents flood damages)	\$8,661	\$1,123	\$1,459	\$2,547
Other Damage (100% of indirect output calculated from annual other flood damages)	\$1,234	\$161	\$244	\$395
Total Indirect and Induced Output	\$20,993	\$2,726	\$3,789	\$6,378
Total increase in Output in the region	\$32,233	\$4,186	\$5,902	\$9,858

Source: DataSource

The output increase can be translated into an increase in employment and earnings as shown in Table C-52.

Table C-52 Increase in Employment and Earnings in the Fargo-Moorhead Region Due to Reconstruction (\$1,000's)

	Without-Project Conditions	With-Project		
		North Dakota East 35k cfs	Minnesota Short 35k cfs	Minnesota Short 20k cfs
Increase in output in region	\$32,233	\$4,186	\$5,902	\$9,858
Increase in employment in region	337	44	62	103
Increase in earnings in region	\$11,752	\$1,526	\$2,152	\$3,594

Source: DataSource

The implication of this loss of business income on State and local taxes was assessed. The results, which incorporate sales tax, personal income tax, corporate income tax, and other miscellaneous tax revenue, are shown in Table C-53. The assumptions used to develop these estimates for tax revenues are provided in Exhibit E.

Table C-53 Total Increase in State and Local Tax Revenue in the Fargo-Moorhead Region due to Reconstruction (\$1,000's)

	Without-Project Conditions	With-Project		
		North Dakota East 35k cfs	Minnesota Short 35k cfs	Minnesota Short 20k cfs
Increase in States Tax Revenue	\$903	\$94	\$132	\$221
Increase in Local Tax Revenue	\$219	\$28	\$40	\$67
Total Increase in States and Local Tax Revenue	\$1,122	\$122	\$172	\$288

Source: DataSource

4.3.2.2 Regional Impacts Associated with Loss of Business Income

As described in Section 4.2.4.4, the annual loss of business income due to flooding under Without-Project conditions is estimated to be \$69.6 million (Table C-54). The USACE estimates that both diversion alternatives would have negligible residual risk of loss of business income. This loss of business income is a direct reduction in output for the region. Because business disruptions caused by a flood ripple through the economy, an output multiplier was applied to determine the total loss in output.

Table C-54 Reduction in Output in the Fargo-Moorhead Region due to Loss of Business Income (\$1,000's)

	Without-Project Conditions	With-Project		
		North Dakota East 35k cfs	Minnesota Short 35k cfs	Minnesota Short 20k cfs
Direct Loss of Business Income	\$65,810	\$0	\$0	\$0
Indirect Loss of Business Income	\$21,658	\$0	\$0	\$0
Total reduction in output in the region	\$87,468	\$0	\$0	\$0

Source: DataSource

The total reduction in output in the Fargo-Moorhead region is estimated to be \$87.5 million annually. This total reduction in output can be translated into an annual reduction in 913 jobs. The implication of this loss of business income on State and local taxes was assessed. The results, which incorporate sales tax, personal income tax, corporate income tax, and other miscellaneous tax revenue, are shown in Table C-55. The assumptions used to develop these estimates for tax revenues are provided in Exhibit E.

Table C-55 Total Reduction in Tax Revenue in the Fargo-Moorhead Region due to Loss of Business Income (\$1,000's)

	Without-Project Conditions	With- Project		
		North Dakota East 35k cfs	Minnesota Short 35k cfs	Minnesota Short 20k cfs
Reduction in States Tax Revenue	\$2,449	\$0	\$0	\$0
Reduction in Local Tax Revenue	\$595	\$0	\$0	\$0
Total Reduction in States and Local Tax Revenue	\$3,044	\$0	\$0	\$0

Source: DataSource

4.3.2.3 Summary of Avoided Losses

The benefit of having a diversion in place is the change in net business losses (losses avoided) (Table C-56). Net business losses are the difference between the following benefits and costs of flooding:

- Costs
 - Local expenditures to repair damages caused by the flood
 - Loss of business income
 - Reduction in State and local tax revenue due to the loss of business income
- Benefits
 - Increase in output due to increased damage caused by the flood
 - Additional State and local tax revenue due to additional output resulting from rebuilding efforts

Table C-56 Avoided Losses in the Fargo-Moorhead Region due to the Flood Diversion Project (\$1,000's)

	Without-Project Conditions	With-Project		
		North Dakota East 35k cfs	Minnesota Short 35k cfs	Minnesota Short 20k cfs
<i>Costs, State & Local Direct/Indirect impacts</i>				
Damage Expenditure	\$61,676	\$8,007	\$11,042	\$18,666
Loss of Business Income	\$87,468	\$0	\$0	\$0
<i>Benefits, State & Local Direct/Indirect/induced impacts</i>				
Increase in Output	\$32,233	\$4,186	\$5,902	\$9,858
Net Loss	\$116,912	\$3,821	\$5,139	\$8,808

The net change in annual employment is calculated as the reduction in employment due to loss of business income less the increase in employment associated with construction (Table C-57).

Table C-57 Avoided Loss in Employment in the Fargo-Moorhead Region due to the Flood Diversion Project

	Without-Project Conditions	With-Project		
		North Dakota East 35k cfs	Minnesota Short 35k cfs	Minnesota Short 20k cfs
Reduction in employment (loss of business income)	913	0	0	0
Increase in employment (reconstruction)	337	44	62	103
Net Loss in Employment	576	-44	-62	-103

Source: DataSource

The net impact of loss of business income and flood damages on State and local taxes is shown in Table C-58. The results incorporate sales tax, personal income tax, corporate income tax, and other miscellaneous tax revenue impacts.

Table C-58 Net Change in Tax Revenue in the Fargo-Moorhead region due to the Flood Diversion Project (\$1,000's)

	Without-Project Conditions	With-Project		
		North Dakota East 35k cfs	Minnesota Short 35k cfs	Minnesota Short 20k cfs
Reduction in States Tax Revenue	\$1,547	-\$94	-\$132	-\$221
Reduction in Local Tax Revenue	\$376	-\$28	-\$40	-\$67
Total Reduction in States and Local Tax Revenues	\$1,923	-\$122	-\$172	-\$288

Source: DataSource

4.3.3 Loss of Business Confidence

Figure C-6 below illustrates the Fargo MSA GDP growth over the next 20 years under the scenarios outlined in Section 4.2.4.5 above.

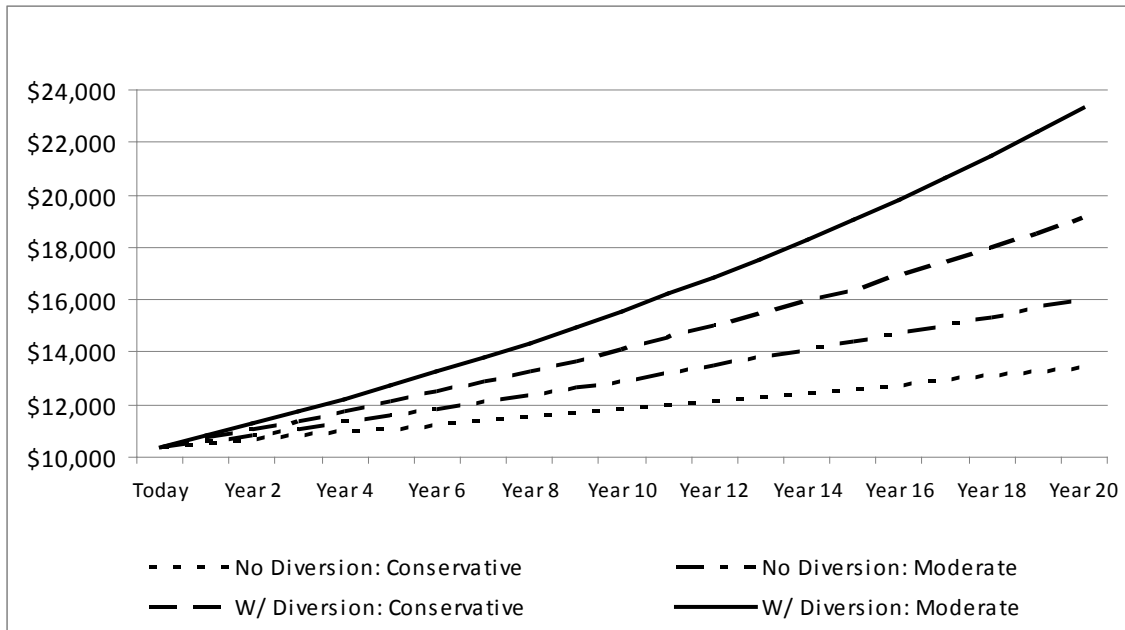


Figure C-6: Projected Real GDP (in Millions 2008 dollars)

Figure C-7 depicts the growth in tax revenues for the States and local taxing districts that result under the four scenarios.

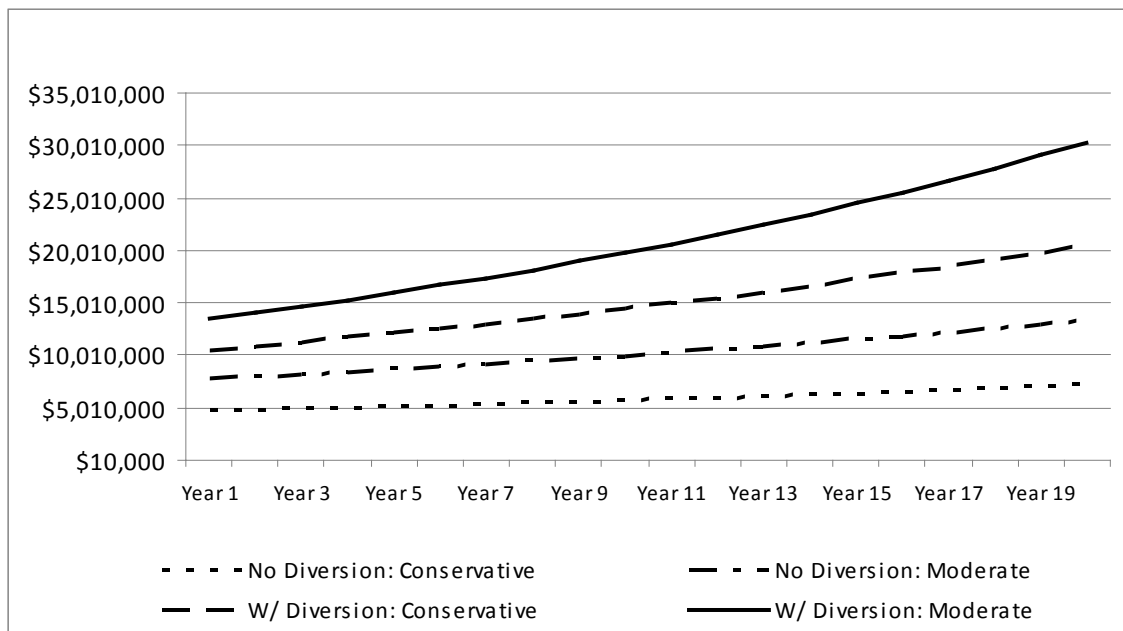


Figure C-7: Growth in Tax Revenues for State and Local Taxing Districts

4.3.3.1 Summary of Projected Economic Growth for Fargo MSA: Without-Project

The additional output in the region that results from general economic growth can be translated into additional employment and earnings in the area. Table C-59 summarizes economic output, employment, and earnings for the two Without-Project cases. In calculating the annual equivalent change in output, employment and earnings, years 1 to 8 were appreciated to the base year (year 9) and then combined with depreciated values from years 9 to 20.

Table C-59 Fargo MSA Economy: Without-Project (\$1,000's)

	Conservative Growth			Moderate Growth		
	<i>Case 1</i>			<i>Case 2</i>		
	Additional Output (MSA GDP)	Additional Employment*	Additional Earnings*	Additional Output (MSA GDP)	Additional Employment*	Additional Earnings*
Year 1	\$134,236	1,402	\$48,943	\$226,849	2,250	\$82,710
Year 2	\$135,968	1,410	\$49,574	\$231,794	2,272	\$84,513
Year 3	\$137,722	1,418	\$50,214	\$236,847	2,294	\$86,355
Year 4	\$139,498	1,426	\$50,862	\$242,010	2,316	\$88,238
Year 5	\$141,298	1,434	\$51,518	\$247,286	2,338	\$90,161
Year 6	\$143,121	1,442	\$52,182	\$252,677	2,360	\$92,127
Year 7	\$144,967	1,450	\$52,855	\$258,185	2,383	\$94,135
Year 8	\$146,837	1,458	\$53,537	\$263,814	2,406	\$96,187
Year 9	\$148,731	1,467	\$54,228	\$269,565	2,429	\$98,284
Year 10	\$150,650	1,475	\$54,927	\$275,442	2,452	\$100,427
Year 11	\$152,593	1,483	\$55,636	\$281,446	2,476	\$102,616
Year 12	\$154,562	1,492	\$56,354	\$287,582	2,499	\$104,853
Year 13	\$156,556	1,500	\$57,081	\$293,851	2,523	\$107,139
Year 14	\$158,575	1,509	\$57,817	\$300,257	2,547	\$109,475
Year 15	\$160,621	1,517	\$58,563	\$306,803	2,572	\$111,861
Year 16	\$162,693	1,526	\$59,318	\$313,491	2,597	\$114,300
Year 17	\$164,791	1,534	\$60,084	\$320,325	2,621	\$116,792
Year 18	\$166,917	1,543	\$60,859	\$327,308	2,647	\$119,338
Year 19	\$169,070	1,552	\$61,644	\$334,443	2,672	\$121,939
Year 20	\$171,252	1,561	\$62,439	\$341,734	2,698	\$124,597
NPV	\$2,822,698	27,775	\$1,029,166	\$5,140,481	46,041	\$1,874,238
Annual Eqv**	\$214,654	2,112	\$78,264	\$390,912	3,501	\$142,528

Source: DataSource

All figures in 2008 dollars.

* Final output multipliers were used to determine employment and earnings. See the Discussion on Multipliers in Section 4.2.4.1 for more information.

** Annual equivalent values were calculated using a discount rate of 0.04375.

4.3.3.2 Summary of Projected Economic Growth for Fargo MSA: With-Project

The additional output in the region that results from general economic growth can be translated into additional employment and earnings in the area. Table C-60 below summarizes economic output, employment, and earnings for the two With-Project cases.

Table C-60 Fargo MSA Economy: With-Project (\$1,000's)

	Conservative Growth			Moderate Growth		
	<i>Case 3</i>			<i>Case 4</i>		
	Additional Output (MSA GDP)	Additional Employment*	Additional Earnings*	Additional Output (MSA GDP)	Additional Employment*	Additional Earnings*
Year 1	\$321,542	2,854	\$117,236	\$427,683	3,349	\$155,935
Year 2	\$331,478	2,893	\$120,858	\$445,260	3,410	\$162,344
Year 3	\$341,721	2,932	\$124,593	\$463,561	3,471	\$169,016
Year 4	\$352,280	2,972	\$128,443	\$482,613	3,534	\$175,962
Year 5	\$363,165	3,012	\$132,411	\$502,448	3,598	\$183,194
Year 6	\$374,387	3,053	\$136,503	\$523,099	3,663	\$190,724
Year 7	\$385,956	3,095	\$140,721	\$544,598	3,729	\$198,563
Year 8	\$397,882	3,137	\$145,069	\$566,981	3,797	\$206,723
Year 9	\$410,176	3,179	\$149,552	\$590,284	3,865	\$215,220
Year 10	\$422,851	3,222	\$154,173	\$614,545	3,935	\$224,065
Year 11	\$435,917	3,266	\$158,937	\$639,803	4,007	\$233,274
Year 12	\$449,387	3,311	\$163,848	\$666,099	4,079	\$242,862
Year 13	\$463,273	3,356	\$168,911	\$693,475	4,153	\$252,844
Year 14	\$477,588	3,401	\$174,130	\$721,977	4,228	\$263,235
Year 15	\$492,345	3,448	\$179,511	\$751,650	4,304	\$274,054
Year 16	\$507,559	3,494	\$185,058	\$782,543	4,382	\$285,318
Year 17	\$523,242	3,542	\$190,776	\$814,706	4,461	\$297,045
Year 18	\$539,411	3,590	\$196,671	\$848,190	4,542	\$309,253
Year 19	\$556,078	3,639	\$202,748	\$883,051	4,624	\$321,963
Year 20	\$573,261	3,688	\$209,013	\$919,344	4,708	\$335,196
NPV	\$7,880,155	60,355	\$2,873,133	\$11,469,219	73,544	\$4,181,718
Annual Eqv**	\$599,252	4,590	\$218,489	\$872,185	5,593	\$318,002

Source: DataSource

All figures in 2008 dollars.

* Final output multipliers were used to determine employment and earnings. See the Discussion on Multipliers in Section 4.2.4.1 for more information.

** Annual equivalent values were calculated using a discount rate of 0.04375.

4.3.3.3 Summary of Projected State and Local Tax Revenue for Fargo MSA: Without-Project

The State and local tax revenues for the Fargo-Moorhead region are summarized in Table C-61 below based on the economic output, employment, and earnings.

**Table C-61 Projected State and Local Tax Revenue for Fargo MSA: Without-Project
(\$1,000's)**

	Conservative Growth			Moderate Growth		
	<i>Case 1</i>			<i>Case 2</i>		
	Additional State Tax Revenue*	Additional Local Tax Revenue**	Additional Total Revenue	Additional State Tax Revenue*	Additional Local Tax Revenue**	Additional Total Revenue
Year 1	\$3,759	\$913	\$4,672	\$6,262	\$1,484	\$7,746
Year 2	\$3,832	\$941	\$4,773	\$6,429	\$1,537	\$7,966
Year 3	\$3,907	\$970	\$4,877	\$6,602	\$1,592	\$8,193
Year 4	\$3,984	\$1,000	\$4,983	\$6,779	\$1,648	\$8,428
Year 5	\$4,062	\$1,031	\$5,093	\$6,962	\$1,707	\$8,669
Year 6	\$4,143	\$1,062	\$5,205	\$7,150	\$1,768	\$8,918
Year 7	\$4,226	\$1,095	\$5,321	\$7,344	\$1,831	\$9,175
Year 8	\$4,311	\$1,129	\$5,440	\$7,543	\$1,897	\$9,440
Year 9	\$4,398	\$1,164	\$5,562	\$7,749	\$1,965	\$9,714
Year 10	\$4,487	\$1,201	\$5,688	\$7,960	\$2,036	\$9,996
Year 11	\$4,579	\$1,238	\$5,817	\$8,178	\$2,109	\$10,287
Year 12	\$4,673	\$1,277	\$5,950	\$8,402	\$2,185	\$10,587
Year 13	\$4,769	\$1,317	\$6,086	\$8,633	\$2,264	\$10,897
Year 14	\$4,868	\$1,359	\$6,227	\$8,871	\$2,346	\$11,217
Year 15	\$4,970	\$1,402	\$6,372	\$9,116	\$2,431	\$11,547
Year 16	\$5,074	\$1,446	\$6,520	\$9,368	\$2,519	\$11,888
Year 17	\$5,181	\$1,492	\$6,674	\$9,629	\$2,611	\$12,239
Year 18	\$5,291	\$1,540	\$6,831	\$9,897	\$2,706	\$12,602
Year 19	\$5,404	\$1,589	\$6,993	\$10,173	\$2,804	\$12,977
Year 20	\$5,520	\$1,640	\$7,160	\$10,457	\$2,906	\$13,364
NPV	\$76,202	\$20,505	\$96,707	\$135,552	\$34,879	\$170,431
Annual Eqv***	\$5,795	\$1,559	\$7,354	\$10,308	\$2,652	\$12,961

Source: DataSource

All figures in 2008 dollars.

* Additional State Tax Revenue includes: Sales Tax, Personal Income Tax, Corporate Income Tax, and Other Miscellaneous Taxes and Revenues.

** Additional Local Tax Revenue includes: Sales Tax and Other Miscellaneous Taxes and Revenues.

*** Annual equivalent values were calculated using a discount rate of 0.04375.

4.3.3.4 Summary of Projected State and Local Tax Revenue for Fargo MSA: With-Project

The State and local tax revenues for the Fargo-Moorhead region are summarized in Table C-62 below based on economic output, employment, and earnings.

Table C-62 Projected State & Local Tax Revenue for Fargo MSA: With-Project (\$1,000's)

	Conservative Growth			Moderate Growth		
	Case 3			Case 4		
	Additional State Tax Revenue*	Additional Local Tax Revenue**	Additional Total Revenue	Additional State Tax Revenue*	Additional Local Tax Revenue**	Additional Total Revenue
Year 1	\$8,619	\$1,936	\$10,555	\$11,122	\$2,352	\$13,474
Year 2	\$8,914	\$2,015	\$10,928	\$11,599	\$2,461	\$14,060
Year 3	\$9,219	\$2,096	\$11,315	\$12,096	\$2,576	\$14,671
Year 4	\$9,535	\$2,182	\$11,716	\$12,614	\$2,695	\$15,309
Year 5	\$9,862	\$2,270	\$12,132	\$13,155	\$2,821	\$15,975
Year 6	\$10,201	\$2,363	\$12,563	\$13,719	\$2,952	\$16,670
Year 7	\$10,551	\$2,459	\$13,010	\$14,307	\$3,089	\$17,396
Year 8	\$10,915	\$2,559	\$13,473	\$14,921	\$3,233	\$18,153
Year 9	\$11,290	\$2,663	\$13,954	\$15,561	\$3,383	\$18,944
Year 10	\$11,680	\$2,772	\$14,452	\$16,228	\$3,541	\$19,769
Year 11	\$12,083	\$2,885	\$14,968	\$16,925	\$3,705	\$20,630
Year 12	\$12,500	\$3,003	\$15,503	\$17,652	\$3,878	\$21,530
Year 13	\$12,932	\$3,126	\$16,058	\$18,409	\$4,059	\$22,468
Year 14	\$13,380	\$3,254	\$16,633	\$19,200	\$4,248	\$23,448
Year 15	\$13,843	\$3,387	\$17,230	\$20,025	\$4,446	\$24,471
Year 16	\$14,323	\$3,526	\$17,849	\$20,885	\$4,653	\$25,538
Year 17	\$14,820	\$3,671	\$18,491	\$21,783	\$4,870	\$26,653
Year 18	\$15,335	\$3,821	\$19,156	\$22,720	\$5,097	\$27,817
Year 19	\$15,868	\$3,978	\$19,847	\$23,697	\$5,335	\$29,031
Year 20	\$16,421	\$4,142	\$20,562	\$24,716	\$5,584	\$30,299
NPV	\$199,788	\$47,684	\$247,472	\$279,664	\$61,260	\$340,924
Annual Eqv***	\$15,193	\$3,626	\$18,819	\$21,267	\$4,659	\$25,926

Source: DataSource

All figures in 2008 dollars.

* Additional State Tax Revenue includes: Sales Tax, Personal Income Tax, Corporate Income Tax, and Other Miscellaneous Taxes and Revenues.

** Additional Local Tax Revenue includes: Sales Tax and Other Miscellaneous Taxes and Revenues.

*** Annual equivalent values were calculated using a discount rate of 0.04375.

4.3.3.5 Determination of Loss of Business Confidence

To determine a range for the loss of business confidence, the potential outcomes of the four combinations of the scenarios were compared as follows:

Potential Outcomes:

Low = (With–Project, Conservative) - (Without-Project, Moderate)

Medium Low = (With-Project, Conservative) - (Without-Project, Conservative)

Medium High = (With-Project, Moderate) - (Without-Project, Moderate)

High = (With-Project, Moderate) - (Without-Project, Conservative)

Table C-63 summarizes loss of business confidence for output, employment, earnings, State tax revenues, local taxing district revenues, and total tax revenues given four potential outcomes. The results are presented as annual equivalent values using a 4.375 percent discount rate over 20 years.

Table C-63 Annual Equivalent Values for Loss of Business Confidence (\$1,000's)

	Low	Medium Low	Medium High	High
Output (MSA GDP)	\$208,340	\$384,598	\$481,273	\$657,531
Employment	1,089	2,478	2,091	3,481
Earnings	\$75,962	\$140,226	\$175,474	\$239,738
State Tax Revenue	\$4,885	\$9,398	\$10,959	\$15,472
Local Tax Revenue	\$974	\$2,067	\$2,006	\$3,099
Total Tax Revenue	\$5,859	\$11,465	\$12,965	\$18,572

All figures in 2008 dollars.

The results show that not providing a permanent flood damage reduction solution may cost the region between \$210 million and \$660 million per year in GDP (2008 dollars). It would also cost the region between 1,089 and 3,481 jobs and between \$5.9 and \$18.6 million in local and State tax revenue.

4.3.4 Business Departing Fargo-Moorhead; Moving Overseas

A potential impact of a failed flood fight in Fargo Moorhead is that a business may move out of the area. This business may leave the region to another location in the United States, or could relocate internationally. This section presents the economic impact of the loss of a hypothetical company that leaves the Fargo-Moorhead area. This hypothetical manufacturing company is assumed to have \$16.5 million in annual revenues and 150 workers.

The loss to the region is the direct loss of annual revenues and a further \$5.3 million in indirect and induced output. In addition to the 150 direct jobs, a further 48 indirect and induced jobs would be lost due to the region. The Federal, State and local tax revenue lost is estimated at \$2.0 million per year.

4.4 Summary and Conclusions

This section summarizes the regional economic impacts for the Fargo-Moorhead flood diversion project in terms of economic output, employment, and tax revenue. The results incorporate regional impacts associated with construction, avoided flood damages (including avoided loss of business income), and loss of business confidence.

All results summarized are shown as annual values. Within this section, the results are presented in two tables for each subsection. The first table summarizes the results for the Without-Project conditions and three With-Project alternatives; North Dakota East 35k cfs, Minnesota Short 35k cfs, and Minnesota Short 20k cfs. The second table calculates the net regional impact of the With-Project alternatives according to the formulae:

Net Regional Economic Benefit = *With-Project* alternative – *Without-Project* alternative

4.4.1 Economic Output

Table C-64 summarizes the changes in economic output within the Fargo-Moorhead MSA associated with each of the flood diversion alternatives. The table highlights the benefit (positive) and cost (negative) effects associated with construction, avoided flood impacts, and loss of business income.

Table C-64 Summary of Changes in Economic Output in the Fargo-Moorhead MSA (\$1,000's)

	Without-Project	With-Project		
		North Dakota East 35k cfs	Minnesota Short 35k cfs	Minnesota Short 20k cfs
Construction Impacts				
Construction	\$0	\$12,895	\$11,380	\$8,670
Operations & Maintenance		(\$1,870)	(\$1,777)	(\$1,358)
Avoided Flood Impacts				
Loss of Business Income	(\$87,468)	\$0	\$0	\$0
NED Construction Benefits	\$32,233	\$4,186	\$5,902	\$9,858
Direct Damages	(\$61,676)	(\$8,007)	(\$11,042)	(\$18,666)
Loss of Business Confidence (Low)	(\$208,340)			
Total	(\$325,251)	\$7,204	\$4,464	(\$1,496)

Table C-65 presents the net change in regional economic output for the North Dakota East 35k cfs, Minnesota Short 35k cfs, and Minnesota Short 20k cfs alternatives.

Table C-65 Changes in Economic Output in the Fargo-Moorhead MSA for the With-Project Alternatives (\$1,000's)

	North Dakota East 35k cfs	Minnesota Short 35k cfs	Minnesota Short 20k cfs
<i>Construction Impacts</i>			
Construction	\$12,895	\$11,380	\$8,670
Operations and Maintenance	(\$1,870)	(\$1,777)	(\$1,358)
<i>Avoided Flood Impacts</i>			
Loss of Business Income	\$87,468	\$87,468	\$87,468
NED Construction Benefits	(\$28,047)	(\$26,331)	(\$22,375)
Direct Damages	\$53,669	\$50,635	\$43,010
<i>Loss of Business Confidence (Low)</i>	\$208,340	\$208,340	\$208,340
Total Increase in GDP	\$332,455	\$329,715	\$323,755

The change in economic output within the Fargo-Moorhead MSA is estimated to be about \$330 million per year. Approximately two-thirds of this impact is associated with the assumed loss of business confidence. The North Dakota alternative provides slightly more regional benefits than the Minnesota alternatives.

4.4.2 Employment

Table C-66 summarizes the changes in employment within the Fargo-Moorhead MSA associated with each of the With-Project alternatives.

Table C-66 Summary of Changes in Employment in the Fargo-Moorhead MSA

	Without-Project	With-Project		
		North Dakota East 35k cfs	Minnesota Short 35k cfs	Minnesota Short 20k cfs
<i>Construction Impacts</i>				
Construction*	0	825	728	555
Operations & Maintenance		26	25	19
<i>Avoided Flood Impacts</i>				
Loss of Business Income	-913			
NED Construction Benefits	337	44	62	103
<i>Loss of Business Confidence (Low)</i>	-1,089			
Total	-1,665	895	815	677

* Employment during construction is the annual equivalent jobs over 50 years.

Table C-67 presents the net change in employment for the North Dakota East 35k cfs, Minnesota Short 35k cfs, and Minnesota Short 20k cfs alternatives.

Table C-67 Changes in Employment in the Fargo-Moorhead MSA for the With-Project Alternative

	North Dakota East 35k cfs	Minnesota Short 35k cfs	Minnesota Short 20k cfs
<i>Construction Impacts</i>			
Construction*	825	728	555
Operations & Maintenance	26	25	19
<i>Avoided Flood Impacts</i>			
Loss of Business Income	913	913	913
NED Construction Benefits	-293	-275	-234
<i>Loss of Business Confidence (Low)</i>	1,089	1,089	1,089
Total	2,560	2,480	2,342

* Employment during construction is the annual equivalent jobs over 50 years.

The With-Project alternatives would produce between 2,340 and 2,560 jobs within the local region.

4.4.3 State and Local Tax Revenue

Table C-68 summarizes the annual changes in State and local tax revenue within the Fargo-Moorhead MSA associated with each of the With-Project alternatives.

Table C-68 Summary of Changes in Annual Tax Revenue in the Fargo-Moorhead MSA (\$1,000's)

	Without-Project	With-Project		
		North Dakota East 35k cfs	Minnesota Short 35k cfs	Minnesota Short 20k cfs
<i>Construction Impacts</i>				
Construction	\$0	\$4,115	\$3,659	\$2,788
Operations & Maintenance		\$90	\$86	\$65
<i>Avoided Flood Impacts</i>				
Loss of Business Income	(\$3,044)			
NED Construction Benefits	\$1,122	\$122	\$172	\$288
<i>Loss of Business Confidence (Low)</i>	(\$5,859)			
Total	(\$7,781)	\$4,327	\$3,917	\$3,140

Table C-69 presents the net annual change in State and local tax revenue for the North Dakota East 35k cfs, Minnesota Short 35k cfs and Minnesota Short 20k cfs alternatives.

Table C-69 Changes in Annual Tax Revenue in the Fargo-Moorhead MSA for the With-Project Alternative (\$1,000's)

	North Dakota East 35k cfs	Minnesota Short 35k cfs	Minnesota Short 20k cfs
<i>Construction Impacts</i>			
Construction	\$4,115	\$3,659	\$2,788
Operations & Maintenance	\$90	\$86	\$65
<i>Avoided Flood Impacts</i>			
Loss of Business Income	\$3,044	\$3,044	\$3,044
NED Construction Benefits	(\$1,000's)	(\$950)	(\$834)
<i>Loss of Business Confidence (Low)</i>	\$5,859	\$5,859	\$5,859
Total	\$12,109	\$11,968	\$10,922

The With-Project alternatives would produce an estimated \$10.9–\$12.1 million of State and local tax revenues.

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Exhibit A

HEC-FDA Output Damages Used in RED Analysis

Structural Damages

Current Conditions

	Estimated Annual Damages (\$,000)						Total
	Fargo North	Fargo South	West Fargo	Moorhead	Cass County	Emergency	
Agricultural	\$8	\$1	\$2	\$10	\$14	---	\$36
Apartment	\$877	\$735	\$91	\$152	\$0	---	\$1,855
College	\$824	\$3	\$0	\$19	\$0	---	\$845
Commercial	\$7,438	\$3,003	\$801	\$181	\$50	---	\$11,473
Public	\$699	\$855	\$11	\$31	\$87	---	\$1,683
Residential	\$4,963	\$6,058	\$2,181	\$1,997	\$2,625	---	\$17,825
Emergency	---	---	---	---	---	\$0	
Total	\$14,809	\$10,655	\$3,087	\$2,391	\$2,776		\$33,720

North Dakota East 35k cfs

	Estimated Annual Damages (\$,000)						Total
	Fargo North	Fargo South	West Fargo	Moorhead	Cass County	Emergency	
Agricultural	\$1	\$0	\$0	\$1	\$1	---	\$4
Apartment	\$103	\$84	\$13	\$17	\$0	---	\$217
College	\$105	\$1	\$0	\$8	\$0	---	\$114
Commercial	\$987	\$367	\$150	\$43	\$4	---	\$1,552
Public	\$94	\$93	\$2	\$10	\$5	---	\$205
Residential	\$598	\$626	\$264	\$303	\$498	---	\$2,290
Emergency	---	---	---	---	---	\$0	
Total	\$1,889	\$1,172	\$429	\$383	\$508		\$4,380

Minnesota South 35k cfs

	Estimated Annual Damages (\$,000)						Total
	Fargo North	Fargo South	West Fargo	Moorhead	Cass County	Emergency	
Agricultural	\$1	\$0	\$0	\$5	\$10	---	\$17
Apartment	\$102	\$81	\$22	\$16	\$0	---	\$221
College	\$102	\$1	\$0	\$8	\$0	---	\$110
Commercial	\$977	\$353	\$143	\$45	\$19	---	\$1,537
Public	\$94	\$92	\$2	\$10	\$37	---	\$235
Residential	\$607	\$681	\$847	\$322	\$1,765	---	\$4,222
Emergency	---	---	---	---	---	\$0	
Total	\$1,882	\$1,208	\$1,015	\$406	\$1,831		\$6,340

Minnesota South 20k cfs

	Estimated Annual Damages (\$,000)						Total
	Fargo North	Fargo South	West Fargo	Moorhead	Cass County	Emergency	
Agricultural	\$2	\$0	\$1	\$6	\$11	---	\$20
Apartment	\$222	\$179	\$34	\$36	\$0	---	\$471
College	\$217	\$1	\$0	\$10	\$0	---	\$228
Commercial	\$1,997	\$757	\$251	\$65	\$23	---	\$3,093
Public	\$181	\$193	\$3	\$14	\$43	---	\$434
Residential	\$1,262	\$1,441	\$1,063	\$570	\$1,861	---	\$6,198
Emergency	---	---	---	---	---	\$0	
Total	\$3,882	\$2,571	\$1,351	\$700	\$1,938		\$10,440

Contents Damages

Current Conditions

	Estimated Annual Damages (\$,000)						Total
	Fargo North	Fargo South	West Fargo	Moorhead	Cass County	Emergency	
Agricultural	\$221	\$1	\$1	\$9	\$13	---	\$245
Apartment	\$1,244	\$1,069	\$131	\$338	\$0	---	\$2,783
College	\$80	\$0	\$0	\$15	\$0	---	\$96
Commercial	\$10,175	\$4,665	\$1,056	\$289	\$58	---	\$16,242
Public	\$829	\$691	\$12	\$47	\$64	---	\$1,643
Residential	\$3,782	\$5,413	\$1,578	\$1,533	\$1,774	---	\$14,081
Emergency	---	---	---	---	---	\$0	
Total	\$16,331	\$11,839	\$2,778	\$2,232	\$1,910		\$35,090

North Dakota East 35k cfs

	Estimated Annual Damages (\$,000)						Total
	Fargo North	Fargo South	West Fargo	Moorhead	Cass County	Emergency	
Agricultural	\$25	\$0	\$0	\$1	\$1	---	\$28
Apartment	\$146	\$122	\$19	\$38	\$0	---	\$325
College	\$10	\$0	\$0	\$6	\$0	---	\$17
Commercial	\$1,351	\$571	\$198	\$69	\$5	---	\$2,193
Public	\$112	\$75	\$2	\$15	\$4	---	\$208
Residential	\$456	\$560	\$191	\$233	\$337	---	\$1,776
Emergency	---	---	---	---	---	\$0	
Total	\$2,100	\$1,328	\$410	\$363	\$346		\$4,550

Minnesota South 35k cfs

	Estimated Annual Damages (\$,000)						Total
	Fargo North	Fargo South	West Fargo	Moorhead	Cass County	Emergency	
Agricultural	\$24	\$0	\$0	\$5	\$9	---	\$39
Apartment	\$144	\$117	\$32	\$37	\$0	---	\$331
College	\$10	\$0	\$0	\$6	\$0	---	\$16
Commercial	\$1,336	\$548	\$189	\$72	\$22	---	\$2,167
Public	\$111	\$74	\$2	\$15	\$28	---	\$230
Residential	\$463	\$609	\$613	\$247	\$1,193	---	\$3,124
Emergency	---	---	---	---	---	\$0	
Total	\$2,089	\$1,349	\$836	\$382	\$1,252		\$5,910

Minnesota South 20k cfs

	Estimated Annual Damages (\$,000)						Total
	Fargo North	Fargo South	West Fargo	Moorhead	Cass County	Emergency	
Agricultural	\$57	\$0	\$0	\$5	\$10	---	\$72
Apartment	\$315	\$261	\$48	\$80	\$0	---	\$704
College	\$21	\$0	\$0	\$8	\$0	---	\$29
Commercial	\$2,732	\$1,176	\$330	\$104	\$27	---	\$4,369
Public	\$215	\$156	\$3	\$21	\$32	---	\$426
Residential	\$962	\$1,288	\$769	\$438	\$1,258	---	\$4,714
Emergency	---	---	---	---	---	\$0	
Total	\$4,301	\$2,880	\$1,152	\$655	\$1,327		\$10,320

Other Damages

Current Conditions

	Estimated Annual Damages (\$,000)						Total
	Fargo North	Fargo South	West Fargo	Moorhead	Cass County	Emergency	
Agricultural	\$0	\$0	\$0	\$0	\$0	---	\$0
Apartment	\$420	\$315	\$46	\$67	\$0	---	\$848
College	\$0	\$0	\$0	\$0	\$0	---	\$0
Commercial	\$1,182	\$4	\$3	\$36	\$0	---	\$1,224
Public	\$2	\$0	\$0	\$40	\$0	---	\$41
Residential	\$346	\$533	\$300	\$127	\$328	---	\$1,634
Emergency	---	---	---	---	---	\$0	
Total	\$1,949	\$852	\$349	\$269	\$328		\$3,750

North Dakota East 35k cfs

	Estimated Annual Damages (\$,000)						Total
	Fargo North	Fargo South	West Fargo	Moorhead	Cass County	Emergency	
Agricultural	\$0	\$0	\$0	\$0	\$0	---	\$0
Apartment	\$49	\$36	\$7	\$8	\$0	---	\$99
College	\$0	\$0	\$0	\$0	\$0	---	\$0
Commercial	\$157	\$0	\$1	\$9	\$0	---	\$166
Public	\$0	\$0	\$0	\$13	\$0	---	\$13
Residential	\$42	\$55	\$36	\$19	\$62	---	\$215
Emergency	---	---	---	---	---	\$0	
Total	\$248	\$92	\$43	\$48	\$62		\$490

Minnesota South 35k cfs

	Estimated Annual Damages (\$,000)						Total
	Fargo North	Fargo South	West Fargo	Moorhead	Cass County	Emergency	
Agricultural	\$0	\$0	\$0	\$0	\$0	---	\$0
Apartment	\$49	\$35	\$11	\$7	\$0	---	\$102
College	\$0	\$0	\$0	\$0	\$0	---	\$0
Commercial	\$155	\$0	\$0	\$9	\$0	---	\$165
Public	\$0	\$0	\$0	\$13	\$0	---	\$13
Residential	\$42	\$60	\$117	\$20	\$220	---	\$460
Emergency	---	---	---	---	---	\$0	
Total	\$246	\$95	\$128	\$49	\$220		\$740

Minnesota South 20k cfs

	Estimated Annual Damages (\$,000)						Total
	Fargo North	Fargo South	West Fargo	Moorhead	Cass County	Emergency	
Agricultural	\$0	\$0	\$0	\$0	\$0	---	\$0
Apartment	\$106	\$77	\$17	\$16	\$0	---	\$216
College	\$0	\$0	\$0	\$0	\$0	---	\$0
Commercial	\$317	\$1	\$1	\$13	\$0	---	\$332
Public	\$0	\$0	\$0	\$17	\$0	---	\$18
Residential	\$88	\$127	\$147	\$36	\$232	---	\$630
Emergency	---	---	---	---	---	\$0	
Total	\$512	\$205	\$164	\$82	\$232		\$1,200

Total Damages

Current Conditions

	Estimated Annual Damages (\$,000)						Total
	Fargo North	Fargo South	West Fargo	Moorhead	Cass County	Emergency	
Agricultural	\$229	\$2	\$3	\$20	\$27	---	\$281
Apartment	\$2,541	\$2,120	\$268	\$557	\$0	---	\$5,486
College	\$904	\$3	\$0	\$34	\$0	---	\$941
Commercial	\$18,794	\$7,671	\$1,860	\$505	\$108	---	\$28,939
Public	\$1,530	\$1,545	\$23	\$118	\$151	---	\$3,368
Residential	\$9,090	\$12,005	\$4,059	\$3,657	\$4,727	---	\$33,539
Emergency	---	---	---	---	---	\$0	
Total	\$33,089	\$23,346	\$6,214	\$4,892	\$5,013		\$72,550

North Dakota East 35k cfs

	Estimated Annual Damages (\$,000)						Total
	Fargo North	Fargo South	West Fargo	Moorhead	Cass County	Emergency	
Agricultural	\$26	\$0	\$1	\$2	\$2	---	\$31
Apartment	\$298	\$243	\$38	\$62	\$0	---	\$641
College	\$115	\$1	\$0	\$15	\$0	---	\$130
Commercial	\$2,495	\$939	\$348	\$121	\$8	---	\$3,911
Public	\$207	\$169	\$4	\$38	\$9	---	\$426
Residential	\$1,096	\$1,241	\$491	\$556	\$897	---	\$4,281
Emergency	---	---	---	---	---	\$0	
Total	\$4,236	\$2,592	\$882	\$794	\$917		\$9,420

Minnesota South 35k cfs

	Estimated Annual Damages (\$,000)						Total
	Fargo North	Fargo South	West Fargo	Moorhead	Cass County	Emergency	
Agricultural	\$25	\$0	\$1	\$10	\$20	---	\$56
Apartment	\$295	\$232	\$66	\$60	\$0	---	\$653
College	\$112	\$1	\$0	\$14	\$0	---	\$127
Commercial	\$2,469	\$902	\$332	\$125	\$42	---	\$3,869
Public	\$205	\$166	\$4	\$39	\$65	---	\$478
Residential	\$1,112	\$1,350	\$1,576	\$589	\$3,178	---	\$7,806
Emergency	---	---	---	---	---	\$0	
Total	\$4,217	\$2,652	\$1,979	\$837	\$3,304		\$12,990

Minnesota South 20k cfs

	Estimated Annual Damages (\$,000)						
	Fargo North	Fargo South	West Fargo	Moorhead	Cass County	Emergency	Total
Agricultural	\$59	\$1	\$1	\$11	\$21	---	\$92
Apartment	\$644	\$516	\$99	\$131	\$0	---	\$1,391
College	\$238	\$1	\$0	\$17	\$0	---	\$257
Commercial	\$5,046	\$1,934	\$581	\$182	\$51	---	\$7,795
Public	\$396	\$349	\$7	\$52	\$74	---	\$877
Residential	\$2,311	\$2,856	\$1,979	\$1,044	\$3,352	---	\$11,542
Emergency	---	---	---	---	---	\$0	
Total	\$8,695	\$5,656	\$2,667	\$1,437	\$3,498		\$21,950

EXHIBIT B
Marshall and Swift Occupancy Codes

OCCID	Definition	Occ_Name	Cat_name	Sales_Class
127	Winery Shop	112	Commercial	L
133	Storage Shed, Prefabricated	114	Commercial	N
135	Hoop Greenhouse, Arch-Rib, Small (under 4,500 square feet)	98	Commercial	M
138	Hoop Greenhouse, Arch-Rib, Large (over 9,000 square feet)	98	Commercial	M
139	Straight Wall Greenhouse, Large (over 9,000 square feet)	98	Commercial	M
140	Modified Hoop Greenhouse, Medium (4,500 - 9,000 square feet)	98	Commercial	M
141	Hoop Greenhouse, Arch-Rib, Medium (4,500 - 9,000 square feet)	98	Commercial	M
157	Storage, Maintenance Building	114	Commercial	N
158	Special Education Classrooms	116	Public	N
170	Institutional Greenhouse, Small (under 4,500 square feet)	98	Commercial	M
171	Institutional Greenhouse, Medium (4,500 - 9,000 square feet)	98	Commercial	M
172	Institutional Greenhouse, Large (over 9,000 square feet)	98	Commercial	M
173	Educational Wing, Church	116	Public	N
174	Pavilion	Pub1	Public	N
175	Skating Rink, Ice	113	Commercial	L
176	Skating Rink, Roller	113	Commercial	L
181	Storage Shed, Prefabricated, Secure	114	Commercial	N
183	Starter Booth, Golf	98	Commercial	L
184	Shelter, Arena	98	Commercial	N
185	Truck Wash	98	Commercial	L
300	Apartment (High Rise)	Apt1	Apartment	N
301	Armory	98	Commercial	N
302	Auditorium	116	Public	N
303	Showroom, Automobile	29	Commercial	L
304	Bank	115	Commercial	N
305	Barn	Storage	Agricultural	N
306	Bowling Center	113	Commercial	L
308	Church with Sunday School	116	Public	N
309	Church	116	Public	N
311	Clubhouse	401	Commercial	N
313	Hospital, Convalescent	52	Commercial	H
314	Country Club	401	Commercial	L
316	Dairy	Storage	Agricultural	N
318	Store, Department	104	Commercial	M
319	Store, Discount	105	Commercial	M
321	Dormitory	Apt2	Apartment	N
322	Fire Station (Staffed)	Pub2	Public	N
323	Fraternal Building	401	Commercial	N
324	Fraternity House	401	Commercial	N
326	Storage Garage	114	Commercial	N
327	Governmental Building	Pub2	Public	N
328	Storage Hangar	114	Commercial	N
329	Hangar, Maintenance and Office	229	Commercial	N
330	Home For The Elderly	52	Commercial	L
331	Hospital	52	Commercial	H
335	Jail, Correctional Facility	Pub2	Public	N
336	Laundromat	107	Commercial	L
337	Library, Public	Pub2	Public	N
339	Storage, Lumber Shed, Horizontal	105	Commercial	L
340	Market	108	Commercial	L
341	Office, Medical	115	Commercial	L
342	Mortuary	133	Commercial	L
343	Motel	132	Commercial	M

OCCID	Definition	Occ_Name	Cat_name	Sales_Class
344	Office Building	115	Commercial	L
345	Parking Structure	98	Commercial	M
348	Rectory	116	Public	N
349	Restaurant, Fast Food	109	Commercial	M
350	Restaurant, Table Service	110	Commercial	M
352	Multiple Residence (Low Rise)	Apt1	Apartment	N
353	Store, Retail	111	Commercial	M
356	Classroom (Elementary and Secondary School)	116	Public	N
358	Gymnasium (Elementary and Secondary School)	116	Public	N
363	Physical Education Building (Elementary and Secondary School)	116	Public	N
364	Science Classrooms (Elementary and Secondary School)	116	Public	N
365	Elementary School (Entire)	116	Public	N
368	Classroom (College)	College1	College	N
369	Commons (College)	College1	College	N
370	Gymnasium (College)	College1	College	N
372	Library, College	College1	College	N
373	Technical Trades Building (College)	College1	College	N
376	Science Building (College)	College1	College	N
377	College (Entire)	College1	College	N
378	Stable	Storage	Agricultural	N
379	Theater, Live Stage	131	Commercial	VL
380	Theater, Cinema	131	Commercial	L
381	Veterinary Hospital	50	Commercial	M
384	Barber Shop	106	Commercial	L
386	Warehouse, Mini	114	Commercial	L
387	Warehouse, Transit	114	Commercial	L
390	Storage, Lumber Building, Vertical	114	Commercial	L
391	Storage, Material Building	114	Commercial	L
392	Industrial Engineering Building	405	Commercial	L
393	Labor Dormitory	Apt1	Apartment	N
396	Hog Barn	Storage	Agricultural	N
397	Sheep Barn	Storage	Agricultural	N
403	Shower Building	98	Commercial	N
406	Warehouse, Storage	114	Commercial	L
407	Warehouse, Distribution	114	Commercial	L
408	Service Station	102	Commercial	M
409	T-Hangar	114	Commercial	L
410	Automotive Center	102	Commercial	M
413	Shopping Center, Community	104	Commercial	M
414	Shopping Center, Regional	104	Commercial	M
418	Health Club	115	Commercial	M
419	Market, Convenience	108	Commercial	M
421	Storage, Grain	Storage	Agricultural	L
423	Mini-Lube Garage	102	Commercial	L
426	Day Care Center	115	Commercial	L
427	Fire Station (Volunteer)	Pub1	Public	N
428	Horse Arena	98	Commercial	L
431	Outpatient (Surgical) Center	50	Commercial	H
432	Restroom Building	98	Commercial	N
434	Self-Serve Car Wash	98	Commercial	L
435	Drive-Thru Car Wash	98	Commercial	L
436	Car Wash, Automatic	98	Commercial	L
442	Tavern/Bar	112	Commercial	L

OCCID	Definition	Occ_Name	Cat_name	Sales_Class
443	Central Bank	115	Commercial	L
444	Office, Dental	50	Commercial	L
446	Supermarket	103	Commercial	M
447	Storage Facility, Cold	405	Commercial	M
451	Multiple Residence, Senior Citizen (Low Rise)	Apt2	Apartment	N
454	Shell, Industrial Building	405	Commercial	L
455	Auto Dealership, Complete	29	Commercial	L
456	Tool Shed	114	Commercial	L
458	Warehouse Discount Store	105	Commercial	L
459	Shopping Center, Mixed with Residential Units	105	Commercial	M
468	Shed, Material Storage	114	Commercial	L
470	Storage, Equipment Shop	114	Commercial	VL
471	Utility Building, Light Commercial	98	Commercial	VL
472	Shed, Equipment	114	Commercial	VL
473	Shelter, Material	114	Commercial	N
476	Storage, Farm Implement	Storage	Agricultural	N
477	Utility Building, Farm	Storage	Agricultural	N
478	Shed, Farm Implement	Storage	Agricultural	N
479	Shed, Farm Utility Storage	Storage	Agricultural	N
481	Museum	Pub2	Public	VL
482	Convention Center	Pub2	Public	L
483	Fitness Center	401	Commercial	L
484	High School (Entire)	116	Public	N
485	Natatorium	116	Public	N
486	Field House	116	Public	N
487	Vocational School	116	Public	N
488	Bookstore (School)	116	Public	N
490	Kennel	98	Commercial	L
491	Government Community Service Building	Pub2	Public	N
492	Shell, Office Building	115	Commercial	VL
493	Storage, Flathouse	Storage	Agricultural	N
494	Industrial Light Manufacturing	405	Commercial	L
495	Industrial Heavy Manufacturing	405	Commercial	L
496	Laboratory	50	Commercial	L
498	Broadcast Facility	115	Commercial	M
499	Laundry/Dry Cleaners	107	Commercial	M
508	Car Wash Canopy	98	Commercial	L
514	Community Center	401	Commercial	VL
515	Casino	112	Commercial	H
518	Lath Shade House (Greenhouse)	98	Commercial	L
519	Shade Shelter (Greenhouse)	98	Commercial	L
523	Storage, Golf Cart Building	114	Commercial	N
526	Shed, Service Garage	102	Commercial	L
527	Municipal Service Garage	102	Commercial	L
528	Service Repair Garage	102	Commercial	L
529	Snack Bar	109	Commercial	L
530	Restaurant, Cafeteria	110	Commercial	M
531	Mini-Mart Convenience Store	108	Commercial	M
532	Florist Shop	56	Commercial	L
533	Warehouse Food Store	103	Commercial	L
534	Warehouse Showroom Store	105	Commercial	L
540	Motel Room, 2 Story, Double Row	132	Commercial	M
543	Motel Room, 1 Story, Single Row	132	Commercial	M

OCCID	Definition	Occ_Name	Cat_name	Sales_Class
544	Office-Apartment (Motel)	132	Commercial	M
552	Recreational Enclosure	98	Commercial	VL
554	Shed Office Structure	115	Commercial	VL
555	Quonset, Light Commercial Arch-Rib	98	Commercial	L
556	Storage, Bulk Oil	Storage	Agricultural	N
557	Quonset, Farm Utility Arch-Rib	Storage	Agricultural	N
558	Quonset, Farm Implement Arch-Rib	Storage	Agricultural	N
561	Shed, Feeder Barn	Storage	Agricultural	N
562	Shed, Farm Commodity Storage	Storage	Agricultural	N
566	Shelter, Farm Sun Shade	Storage	Agricultural	N
571	Passenger Terminal	115	Commercial	N
574	Visitor Center	Pub2	Public	N
577	Parking Levels	98	Commercial	M
578	Mini Bank	115	Commercial	N
580	Truck Stop	98	Commercial	L
581	Post Office, Main	Pub2	Public	N
582	Post Office, Branch	Pub2	Public	N
584	Warehouse, Mega	114	Commercial	L
585	Penthouse, Mechanical	405	Commercial	L
588	Motel, Extended Stay	132	Commercial	M
589	Multiple Residence, Assisted Living (Low Rise)	Apt2	Apartment	N
594	Hotel, Full Service	132	Commercial	M
595	Hotel, Limited Service	132	Commercial	M
597	Retail Mixed with Office Units	111	Commercial	M
598	Relocatable Classroom	116	Public	N
600	Administration Building	Pub2	Public	N
700	Store, Department, Mall Anchor	104	Commercial	M
710	Retirement Community Complex (Multiple Residence)	Apt2	Apartment	N
984	Luxury Apartment (High Rise)	Apt2	Apartment	N
987	Multiple Residence (Low Rise), Interior Space	Apt2	Apartment	N
993	Office Building, Interior Space	115	Commercial	L

EXHIBIT C

Local and State Tax Detailed Calculations – Construction Used for RED Analysis

Construction

Detailed Calculations for State & Local Tax Revenue

North Dakota East 35k cfs

All values are in \$1,000

Revenues for the State and Local Taxing Districts During Construction

Sales Tax to be Collected

Construction Workers' Spending Subject to Sales Tax

An estimated 33% of the spending of direct construction workers and related indirect workers will be subject to sales taxes. Further, an estimated 70% of this spending will be in the Fargo-Moorhead area. If this is the case, retail sales in the area generated by workers during construction will be as follows.

Taxable Retail Sales in the Area to be Generated by Construction Workers	
Year 1	\$35,242
Year 2	\$35,242
Year 3	\$35,242
Year 4	\$35,242
Year 5	\$35,242
Year 6	\$35,242
Year 7	\$35,242
Year 8	\$35,242
Total	\$281,934

Source: Impact DataSource calculations based on estimated spending in the area

Sales Tax Collections

The states of North Dakota and Minnesota and local taxing districts will collect the following sales tax on construction workers' spending:

Estimated Sales Tax Collections on Construction Workers' Spending			
	States	Local Taxing Districts	Total
Effective sales tax rate	5.33%	1.65%	
Year 1	\$1,879	\$580	\$2,459
Year 2	\$1,879	\$580	\$2,459
Year 3	\$1,879	\$580	\$2,459
Year 4	\$1,879	\$580	\$2,459
Year 5	\$1,879	\$580	\$2,459
Year 6	\$1,879	\$580	\$2,459
Year 7	\$1,879	\$580	\$2,459
Year 8	\$1,879	\$580	\$2,459
Total	\$15,034	\$4,639	\$19,673

Source: Sales tax rates for each state and local taxing districts obtained from each state's department of revenue or local taxing district. Effective sales tax rates, blending the tax rates of two states and several local taxing districts, were determined in calculations by Impact DataSource based on the number of business establishments in Cass and Clay Counties.

Lodging Tax to be Collected

Construction Workers' Spending on Lodging

An estimated 20% of the direct construction workers may be from out-of-town and stay in local motels during construction of the project. If this is the case, there is double occupancy and a nightly room rate at local motels where construction workers stay is \$85, then the construction workers from out of town spend the following amounts that will be subject to lodging taxes:

Taxable Lodging Sales	
	Amount
Year 1	\$3,968
Year 2	\$4,087
Year 3	\$4,209
Year 4	\$4,336
Year 5	\$4,466
Year 6	\$4,600
Year 7	\$4,738
Year 8	\$4,880
Total	\$35,283

Lodging Tax Collections

The states and local taxing districts will collect the following lodging tax on spending by out-of-town construction workers on lodging:

Estimated Lodging Tax Collections on Out-of-Town Construction Workers' Spending on Lodging			
	States	Local Taxing Districts	Total
Effective lodging tax rate	0%	3%	
Year 1	\$0	\$119	\$119
Year 2	\$0	\$123	\$123
Year 3	\$0	\$126	\$126
Year 4	\$0	\$130	\$130
Year 5	\$0	\$134	\$134
Year 6	\$0	\$138	\$138
Year 7	\$0	\$142	\$142
Year 8	\$0	\$146	\$146
Total	\$0	\$1,058	\$1,058

Source: Lodging taxes for local taxing districts obtained from each state's department of revenue or local taxing district. Effective lodging tax rates, blending the tax rates of multiple local taxing districts, were determined in calculations by Impact DataSource based on the number of business establishments in Cass and Clay Counties.

State Personal Income Taxes to be Collected

During construction, salaries of direct, indirect and induced workers may be subject to North Dakota and Minnesota personal income taxes. If this is the case, the states will collect the following personal income taxes:

Estimated State Personal Income Taxes to be Collected During Construction				
	Total Direct and Indirect Construction Payrolls	Percent of Salaries Subject to State Personal Income Tax	Effective Personal Income Tax Rate as a Percent of Total Income	Total Personal Income Tax Collections
Year 1	\$152,562	100%	2.547%	\$3,885
Year 2	\$152,562	100%	2.547%	\$3,885
Year 3	\$152,562	100%	2.547%	\$3,885
Year 4	\$152,562	100%	2.547%	\$3,885
Year 5	\$152,562	100%	2.547%	\$3,885
Year 6	\$152,562	100%	2.547%	\$3,885
Year 7	\$152,562	100%	2.547%	\$3,885
Year 8	\$152,562	100%	2.547%	\$3,885
Total	\$1,220,494			\$31,081

Source: Personal income tax rates were obtained from each state's department of revenue.

Effective state personal income tax rates, blending the tax rates North Dakota, were determined in calculations by Impact DataSource based on median household income in the area and the percentage of labor force in Cass and Clay Counties. The percent of workers whose salaries will be subject to personal income taxes in the two states are Impact DataSource estimates.

State Corporate Income Taxes to be Collected

During construction and equipment installation, an estimated 8% of the total economic output generated by construction activities or business income may be subject to North Dakota or Minnesota corporate income tax. If this is the case, the states will collect the following corporate income taxes during construction:

Estimated Corporate Income Taxes to be Collected During Construction				
	Total Direct and Indirect Construction Spending/ Revenues for Businesses	Percent of Revenues Subject to State Corporate Income Tax	Effective Corporate Income Tax Rate as a Percent of Net Income	Total Corporate Income Tax Collections
Year 1	\$226,719	8%	7.003%	\$1,270
Year 2	\$226,719	8%	7.003%	\$1,270
Year 3	\$226,719	8%	7.003%	\$1,270
Year 4	\$226,719	8%	7.003%	\$1,270
Year 5	\$226,719	8%	7.003%	\$1,270
Year 6	\$226,719	8%	7.003%	\$1,270
Year 7	\$226,719	8%	7.003%	\$1,270
Year 8	\$226,719	8%	7.003%	\$1,270
Total	\$1,813,755			\$10,161

Source: Corporate income tax rates were obtained from each state's department of revenue. Effective state corporate income tax rates, blending the tax rates North Dakota, were determined in calculations by Impact DataSource based on the percentage of business establishments in Cass and Clay Counties. The percent of total business revenues that will be subject to state corporation income taxes in the two states are Impact DataSource estimates.

Other Taxes, User Fees, Charges for Services and Miscellaneous Revenues for the States and Local Taxing Districts Collected from Construction Workers

During construction, the states and local taxing districts will collect other taxes, user fees, charges for services, and miscellaneous revenues primarily from workers. These estimated annual revenues to be collected per worker are shown below:

Annual Miscellaneous Revenues Collected Per Worker	
States	\$764.41
Local taxing districts	\$500

Source: Miscellaneous revenues per worker for states calculated by Impact DataSource from information shown in the general fund budgets of each state along with the number of workers in each state. Further, miscellaneous revenues for each state were blending to obtain an average by Impact DataSource based on relative number of workers in Cass and Clay Counties. Miscellaneous revenues for local taxing districts are Impact DataSource estimates.

If these estimated miscellaneous revenues are received by the states and local taxing districts for each worker and an estimated 70% of the workers may live in the Fargo-Moorhead area, the following revenues will be received during the project's construction:

Estimated Miscellaneous Revenues for the States and Local Taxing Districts During Construction					
	Number of Workers in the States	Number of Local Workers	Miscellaneous Revenues		
			State	Local Taxing Districts	Total
Year 1	2,079	1,455	\$1,589	\$1,040	\$2,629
Year 2	2,079	1,455	\$1,589	\$1,040	\$2,629
Year 3	2,079	1,455	\$1,589	\$1,040	\$2,629
Year 4	2,079	1,455	\$1,589	\$1,040	\$2,629
Year 5	2,079	1,455	\$1,589	\$1,040	\$2,629
Year 6	2,079	1,455	\$1,589	\$1,040	\$2,629
Year 7	2,079	1,455	\$1,589	\$1,040	\$2,629
Year 8	2,079	1,455	\$1,589	\$1,040	\$2,629
Total			\$12,715	\$8,317	\$21,033

Source: Percent of total direct and indirect construction workers who may live in the Fargo-Moorhead area is an Impact DataSource estimate.

Summary of Taxes and Other Revenues to be Collected by the States and Local Taxing Districts During Construction

Revenues for the States

During construction, the project will generate the following revenues for the states:

Total Revenues for the States During Construction						
	Sales Taxes	Lodging Taxes	Corporate Income Taxes	Personal Income Taxes	Other Taxes and Revenues	Total
Year 1	\$1,879	\$0	\$1,270	\$3,885	\$1,589	\$8,624
Year 2	\$1,879	\$0	\$1,270	\$3,885	\$1,589	\$8,624
Year 3	\$1,879	\$0	\$1,270	\$3,885	\$1,589	\$8,624
Year 4	\$1,879	\$0	\$1,270	\$3,885	\$1,589	\$8,624
Year 5	\$1,879	\$0	\$1,270	\$3,885	\$1,589	\$8,624
Year 6	\$1,879	\$0	\$1,270	\$3,885	\$1,589	\$8,624
Year 7	\$1,879	\$0	\$1,270	\$3,885	\$1,589	\$8,624
Year 8	\$1,879	\$0	\$1,270	\$3,885	\$1,589	\$8,624
Total	\$15,034	\$0	\$10,161	\$31,081	\$12,715	\$68,992

Revenues for Local Taxing Districts

During construction, the project will generate the following revenues for local taxing districts:

Total Revenues for Local Taxing District During Construction				
	Sales Taxes	Lodging Taxes	Other Taxes and Revenues	Total Revenues
Year 1	\$580	\$119	\$1,040	\$1,739
Year 2	\$580	\$123	\$1,040	\$1,742
Year 3	\$580	\$126	\$1,040	\$1,746
Year 4	\$580	\$130	\$1,040	\$1,750
Year 5	\$580	\$134	\$1,040	\$1,753
Year 6	\$580	\$138	\$1,040	\$1,757
Year 7	\$580	\$142	\$1,040	\$1,762
Year 8	\$580	\$146	\$1,040	\$1,766
Total	\$4,639	\$1,058	\$8,317	\$14,014

\$694.79

Total Revenues for the States and Local Taxing Districts

During construction, the project will generate the following total revenues for the states and local taxing districts:

Total Revenues for the States and Local Taxing Districts During Construction						
	Sales Tax Collections	Lodging Taxes	Corporate Income Taxes	Personal Income Taxes	Other Taxes and Revenues	Total
Year 1	\$2,459	\$119	\$1,270	\$3,885	\$2,629	\$10,363
Year 2	\$2,459	\$123	\$1,270	\$3,885	\$2,629	\$10,366
Year 3	\$2,459	\$126	\$1,270	\$3,885	\$2,629	\$10,370
Year 4	\$2,459	\$130	\$1,270	\$3,885	\$2,629	\$10,374
Year 5	\$2,459	\$134	\$1,270	\$3,885	\$2,629	\$10,377
Year 6	\$2,459	\$138	\$1,270	\$3,885	\$2,629	\$10,381
Year 7	\$2,459	\$142	\$1,270	\$3,885	\$2,629	\$10,386
Year 8	\$2,459	\$146	\$1,270	\$3,885	\$2,629	\$10,390
Total	\$19,673	\$1,058	\$10,161	\$31,081	\$21,033	\$83,006

Summary of Total Revenues for the States and Local Taxing Districts

During construction, the project will generate the following total revenues for the states and local taxing districts:

Summary of Annual Tax Revenues for the States and Local Taxing Districts During Construction	
States of North Dakota and Minnesota	\$3,420
Local taxing districts	\$695
Total	\$4,115

Construction

Detailed Calculations for State & Local Tax Revenue

Minnesota South 35k cfs

All values are in \$1,000

Revenues for the State and Local Taxing Districts During Construction

Sales Tax to be Collected

Construction Workers' Spending Subject to Sales Tax

An estimated 33% of the spending of direct construction workers and related indirect workers will be subject to sales taxes. Further, an estimated 70% of this spending will be in the Fargo-Moorhead area. If this is the case, retail sales in the area generated by workers during construction will be as follows.

Taxable Retail Sales in the Area to be Generated by Construction Workers	
Year 1	\$41,467
Year 2	\$41,467
Year 3	\$41,467
Year 4	\$41,467
Year 5	\$41,467
Year 6	\$41,467
Total	\$248,800

Source: Impact DataSource calculations based on estimated spending in the area

Sales Tax Collections

The states of North Dakota and Minnesota and local taxing districts will collect the following sales tax on construction workers' spending:

Estimated Sales Tax Collections on Construction Workers' Spending			
	States	Local Taxing Districts	Total
Effective sales tax rate	5.33%	1.65%	
Year 1	\$2,211	\$682	\$2,893
Year 2	\$2,211	\$682	\$2,893
Year 3	\$2,211	\$682	\$2,893
Year 4	\$2,211	\$682	\$2,893
Year 5	\$2,211	\$682	\$2,893
Year 6	\$2,211	\$682	\$2,893
Total	\$13,267	\$4,093	\$17,361

Source: Sales tax rates for each state and local taxing districts obtained from each state's department of revenue or local taxing district. Effective sales tax rates, blending the tax rates of two states and several local taxing districts, were determined in calculations by Impact DataSource based on the number of business establishments in Cass and Clay Counties.

Lodging Tax to be Collected

Construction Workers' Spending on Lodging

An estimated 20% of the direct construction workers may be from out-of-town and stay in local motels during construction of the project. If this is the case, there is double occupancy and a nightly room rate at local motels where construction workers stay is \$85, then the construction workers from out of town spend the following amounts that will be subject to lodging taxes:

Taxable Lodging Sales	
	Amount
Year 1	\$4,669
Year 2	\$4,809
Year 3	\$4,953
Year 4	\$5,102
Year 5	\$5,255
Year 6	\$5,413
Total	\$30,201

Lodging Tax Collections

The states and local taxing districts will collect the following lodging tax on spending by out-of-town construction workers on lodging:

Estimated Lodging Tax Collections on Out-of-Town Construction Workers' Spending on Lodging			
	States	Local Taxing Districts	Total
Effective lodging tax rate	0%	3%	
Year 1	\$0	\$140	\$140
Year 2	\$0	\$144	\$144
Year 3	\$0	\$149	\$149
Year 4	\$0	\$153	\$153
Year 5	\$0	\$158	\$158
Year 6	\$0	\$162	\$162
Total	\$0	\$906	\$906

Source: Lodging taxes for local taxing districts obtained from each state's department of revenue or local taxing district. Effective lodging tax rates, blending the tax rates of multiple local taxing districts, were determined in calculations by Impact DataSource based on the number of business establishments in Cass and Clay Counties.

State Personal Income Taxes to be Collected

During construction, salaries of direct, indirect and induced workers may be subject to North Dakota and Minnesota personal income taxes. If this is the case, the states will collect the following personal income taxes:

Estimated State Personal Income Taxes to be Collected During Construction				
	Total Direct and Indirect Construction Payrolls	Percent of Salaries Subject to State Personal Income Tax	Effective Personal Income Tax Rate as a Percent of Total Income	Total Personal Income Tax Collections
Year 1	\$179,509	100%	2.547%	\$4,571
Year 2	\$179,509	100%	2.547%	\$4,571
Year 3	\$179,509	100%	2.547%	\$4,571
Year 4	\$179,509	100%	2.547%	\$4,571
Year 5	\$179,509	100%	2.547%	\$4,571
Year 6	\$179,509	100%	2.547%	\$4,571
Total	\$1,077,054			\$27,428

Source: Personal income tax rates were obtained from each state's department of revenue. Effective state personal income tax rates, blending the tax rates North Dakota, were determined in calculations by Impact DataSource based on median household income in the area and the percentage of labor force in Cass and Clay Counties. The percent of workers whose salaries will be subject to personal income taxes in the two states are Impact DataSource estimates.

State Corporate Income Taxes to be Collected

During construction and equipment installation, an estimated 8% of the total economic output generated by construction activities or business income may be subject to North Dakota or Minnesota corporate income tax. If this is the case, the states will collect the following corporate income taxes during construction:

Estimated Corporate Income Taxes to be Collected During Construction				
	Total Direct and Indirect Construction Spending/ Revenues for Businesses	Percent of Revenues Subject to State Corporate Income Tax	Effective Corporate Income Tax Rate as a Percent of Net Income	Total Corporate Income Tax Collections
Year 1	\$266,765	8%	7.003%	\$1,495
Year 2	\$266,765	8%	7.003%	\$1,495
Year 3	\$266,765	8%	7.003%	\$1,495
Year 4	\$266,765	8%	7.003%	\$1,495
Year 5	\$266,765	8%	7.003%	\$1,495
Year 6	\$266,765	8%	7.003%	\$1,495
Total	\$1,600,591			\$8,967

Source: Corporate income tax rates were obtained from each state's department of revenue. Effective state corporate income tax rates, blending the tax rates North Dakota, were determined in calculations by Impact DataSource based on the percentage of business establishments in Cass and Clay Counties. The percent of total business revenues that will be subject to state corporation income taxes in the two states are Impact DataSource estimates.

Other Taxes, User Fees, Charges for Services and Miscellaneous Revenues for the States and Local Taxing Districts Collected from Construction Workers

During construction, the states and local taxing districts will collect other taxes, user fees, charges for services, and miscellaneous revenues primarily from workers. These estimated annual revenues to be collected per worker are shown below:

Annual Miscellaneous Revenues Collected Per Worker	
States	\$764.41
Local taxing districts	\$500

Source: Miscellaneous revenues per worker for states calculated by Impact DataSource from information shown in the general fund budgets of each state along with the number of workers in each state. Further, miscellaneous revenues for each state were blending to obtain an average by Impact DataSource based on relative number of workers in Cass and Clay Counties. Miscellaneous revenues for local taxing districts are Impact DataSource estimates.

If these estimated miscellaneous revenues are received by the states and local taxing districts for each worker and an estimated 70% of the workers may live in the Fargo-Moorhead area, the following revenues will be received during the project's construction:

Estimated Miscellaneous Revenues for the States and Local Taxing Districts During Construction					
	Number of Workers in the States	Number of Local Workers	Miscellaneous Revenues		
			State	Local Taxing Districts	Total
Year 1	2,447	1,713	\$1,870	\$1,223	\$3,094
Year 2	2,447	1,713	\$1,870	\$1,260	\$3,130
Year 3	2,447	1,713	\$1,870	\$1,298	\$3,168
Year 4	2,447	1,713	\$1,870	\$1,337	\$3,207
Year 5	2,447	1,713	\$1,870	\$1,377	\$3,247
Year 6	2,447	1,713	\$1,870	\$1,418	\$3,289
Total			\$11,222	\$7,913	\$19,135

Source: Percent of total direct and indirect construction workers who may live in the Fargo-Moorhead area is an Impact DataSource estimate.

Summary of Taxes and Other Revenues to be Collected by the States and Local Taxing Districts During Construction

Revenues for the States

During construction, the project will generate the following revenues for the states:

Total Revenues for the States During Construction						
	Sales Taxes	Lodging Taxes	Corporate Income Taxes	Personal Income Taxes	Other Taxes and Revenues	Total
Year 1	\$2,211	\$0	\$1,495	\$4,571	\$1,870	\$10,147
Year 2	\$2,211	\$0	\$1,495	\$4,571	\$1,870	\$10,147
Year 3	\$2,211	\$0	\$1,495	\$4,571	\$1,870	\$10,147
Year 4	\$2,211	\$0	\$1,495	\$4,571	\$1,870	\$10,147
Year 5	\$2,211	\$0	\$1,495	\$4,571	\$1,870	\$10,147
Year 6	\$2,211	\$0	\$1,495	\$4,571	\$1,870	\$10,147
Total	\$13,267	\$0	\$8,967	\$27,428	\$11,222	\$60,885

Revenues for Local Taxing Districts

During construction, the project will generate the following revenues for local taxing districts:

Total Revenues for Local Taxing District During Construction				
	Sales Taxes	Lodging Taxes	Other Taxes and Revenues	Total Revenues
Year 1	\$682	\$140	\$1,223	\$2,046
Year 2	\$682	\$144	\$1,260	\$2,087
Year 3	\$682	\$149	\$1,298	\$2,129
Year 4	\$682	\$153	\$1,337	\$2,172
Year 5	\$682	\$158	\$1,377	\$2,217
Year 6	\$682	\$162	\$1,418	\$2,263
Total	\$4,093	\$906	\$7,913	\$12,913

Total Revenues for the States and Local Taxing Districts

During construction, the project will generate the following total revenues for the states and local taxing districts:

Total Revenues for the States and Local Taxing Districts During Construction						
	Sales Tax Collections	Lodging Taxes	Corporate Income Taxes	Personal Income Taxes	Other Taxes and Revenues	Total
Year 1	\$2,893	\$140	\$1,495	\$4,571	\$3,094	\$12,193
Year 2	\$2,893	\$144	\$1,495	\$4,571	\$3,130	\$12,234
Year 3	\$2,893	\$149	\$1,495	\$4,571	\$3,168	\$12,276
Year 4	\$2,893	\$153	\$1,495	\$4,571	\$3,207	\$12,320
Year 5	\$2,893	\$158	\$1,495	\$4,571	\$3,247	\$12,364
Year 6	\$2,893	\$162	\$1,495	\$4,571	\$3,289	\$12,410
Total	\$17,361	\$906	\$8,967	\$27,428	\$19,135	\$73,797

Summary of Total Revenues for the States and Local Taxing Districts

During construction, the project will generate the following total revenues for the states and local taxing districts:

Summary of Annual Tax Revenues for the States and Local Taxing Districts During Construction	
States of North Dakota and Minnesota	\$3,018
Local taxing districts	\$640
Total	\$3,659

Construction

Detailed Calculations for State & Local Tax Revenue

Minnesota South 20k cfs

All values are in \$1,000

Revenues for the State and Local Taxing Districts During Construction

Sales Tax to be Collected

Construction Workers' Spending Subject to Sales Tax

An estimated 33% of the spending of direct construction workers and related indirect workers will be subject to sales taxes. Further, an estimated 70% of this spending will be in the Fargo-Moorhead area. If this is the case, retail sales in the area generated by workers during construction will be as follows.

Taxable Retail Sales in the Area to be Generated by Construction Workers	
Year 1	\$31,594
Year 2	\$31,594
Year 3	\$31,594
Year 4	\$31,594
Year 5	\$31,594
Year 6	\$31,594
Total	\$189,562

Source: Impact DataSource calculations based on estimated spending in the area

Sales Tax Collections

The states of North Dakota and Minnesota and local taxing districts will collect the following sales tax on construction workers' spending:

Estimated Sales Tax Collections on Construction Workers' Spending			
	States	Local Taxing Districts	Total
Effective sales tax rate	5.33%	1.65%	
Year 1	\$1,685	\$520	\$2,205
Year 2	\$1,685	\$520	\$2,205
Year 3	\$1,685	\$520	\$2,205
Year 4	\$1,685	\$520	\$2,205
Year 5	\$1,685	\$520	\$2,205
Year 6	\$1,685	\$520	\$2,205
Total	\$10,108	\$3,119	\$13,227

Source: Sales tax rates for each state and local taxing districts obtained from each state's department of revenue or local taxing district. Effective sales tax rates, blending the tax rates of two states and several local taxing districts, were determined in calculations by Impact DataSource based on the number of business establishments in Cass and Clay Counties.

Lodging Tax to be Collected

Construction Workers' Spending on Lodging

An estimated 20% of the direct construction workers may be from out-of-town and stay in local motels during construction of the project. If this is the case, there is double occupancy and a nightly room rate at local motels where construction workers stay is \$85, then the construction workers from out of town spend the following amounts that will be subject to lodging taxes:

Taxable Lodging Sales	
	Amount
Year 1	\$3,557
Year 2	\$3,664
Year 3	\$3,774
Year 4	\$3,887
Year 5	\$4,004
Year 6	\$4,124
Total	\$23,010

Lodging Tax Collections

The states and local taxing districts will collect the following lodging tax on spending by out-of-town construction workers on lodging:

Estimated Lodging Tax Collections on Out-of-Town Construction Workers' Spending on Lodging			
	States	Local Taxing Districts	Total
Effective lodging tax rate	0%	3%	
Year 1	\$0	\$107	\$107
Year 2	\$0	\$110	\$110
Year 3	\$0	\$113	\$113
Year 4	\$0	\$117	\$117
Year 5	\$0	\$120	\$120
Year 6	\$0	\$124	\$124
Total	\$0	\$690	\$690

Source: Lodging taxes for local taxing districts obtained from each state's department of revenue or local taxing district. Effective lodging tax rates, blending the tax rates of multiple local taxing districts, were determined in calculations by Impact DataSource based on the number of business establishments in Cass and Clay Counties.

State Personal Income Taxes to be Collected

During construction, salaries of direct, indirect and induced workers may be subject to North Dakota and Minnesota personal income taxes. If this is the case, the states will collect the following personal income taxes:

Estimated State Personal Income Taxes to be Collected During Construction				
	Total Direct and Indirect Construction Payrolls	Percent of Salaries Subject to State Personal Income Tax	Effective Personal Income Tax Rate as a Percent of Total Income	Total Personal Income Tax Collections
Year 1	\$136,769	100%	2.547%	\$3,483
Year 2	\$136,769	100%	2.547%	\$3,483
Year 3	\$136,769	100%	2.547%	\$3,483
Year 4	\$136,769	100%	2.547%	\$3,483
Year 5	\$136,769	100%	2.547%	\$3,483
Year 6	\$136,769	100%	2.547%	\$3,483
Total	\$820,615			\$20,898

Source: Personal income tax rates were obtained from each state's department of revenue. Effective state personal income tax rates, blending the tax rates North Dakota, were determined in calculations by Impact DataSource based on median household income in the area and the percentage of labor force in Cass and Clay Counties. The percent of workers whose salaries will be subject to personal income taxes in the two states are Impact DataSource estimates.

State Corporate Income Taxes to be Collected

During construction and equipment installation, an estimated 8% of the total economic output generated by construction activities or business income may be subject to North Dakota or Minnesota corporate income tax. If this is the case, the states will collect the following corporate income taxes during construction:

Estimated Corporate Income Taxes to be Collected During Construction				
	Total Direct and Indirect Construction Spending/ Revenues for Businesses	Percent of Revenues Subject to State Corporate Income Tax	Effective Corporate Income Tax Rate as a Percent of Net Income	Total Corporate Income Tax Collections
Year 1	\$203,250	8%	7.003%	\$1,139
Year 2	\$203,250	8%	7.003%	\$1,139
Year 3	\$203,250	8%	7.003%	\$1,139
Year 4	\$203,250	8%	7.003%	\$1,139
Year 5	\$203,250	8%	7.003%	\$1,139
Year 6	\$203,250	8%	7.003%	\$1,139
Total	\$1,219,502			\$6,832

Source: Corporate income tax rates were obtained from each state's department of revenue. Effective state corporate income tax rates, blending the tax rates North Dakota, were determined in calculations by Impact DataSource based on the percentage of business establishments in Cass and Clay Counties. The percent of total business revenues that will be subject to state corporation income taxes in the two states are Impact DataSource estimates.

Other Taxes, User Fees, Charges for Services and Miscellaneous Revenues for the States and Local Taxing Districts Collected from Construction Workers

During construction, the states and local taxing districts will collect other taxes, user fees, charges for services, and miscellaneous revenues primarily from workers. These estimated annual revenues to be collected per worker are shown below:

Annual Miscellaneous Revenues Collected Per Worker	
States	\$764.41
Local taxing districts	\$500

Source: Miscellaneous revenues per worker for states calculated by Impact DataSource from information shown in the general fund budgets of each state along with the number of workers in each state. Further, miscellaneous revenues for each state were blending to obtain an average by Impact DataSource based on relative number of workers in Cass and Clay Counties. Miscellaneous revenues for local taxing districts are Impact DataSource estimates.

If these estimated miscellaneous revenues are received by the states and local taxing districts for each worker and an estimated 70% of the workers may live in the Fargo-Moorhead area, the following revenues will be received during the project's construction:

Estimated Miscellaneous Revenues for the States and Local Taxing Districts During Construction					
	Number of Workers in the States	Number of Local Workers	Miscellaneous Revenues		Total
			State	Local Taxing Districts	
Year 1	1,864	1,305	\$1,425	\$932	\$2,357
Year 2	1,864	1,305	\$1,425	\$960	\$2,385
Year 3	1,864	1,305	\$1,425	\$989	\$2,414
Year 4	1,864	1,305	\$1,425	\$1,018	\$2,443
Year 5	1,864	1,305	\$1,425	\$1,049	\$2,474
Year 6	1,864	1,305	\$1,425	\$1,081	\$2,505
Total			\$8,550	\$6,029	\$14,579

Source: Percent of total direct and indirect construction workers who may live in the Fargo-Moorhead area is an Impact DataSource estimate.

Summary of Taxes and Other Revenues to be Collected by the States and Local Taxing Districts During Construction

Revenues for the States

During construction, the project will generate the following revenues for the states:

Total Revenues for the States During Construction						
	Sales Taxes	Lodging Taxes	Corporate Income Taxes	Personal Income Taxes	Other Taxes and Revenues	Total
Year 1	\$1,685	\$0	\$1,139	\$3,483	\$1,425	\$7,731
Year 2	\$1,685	\$0	\$1,139	\$3,483	\$1,425	\$7,731
Year 3	\$1,685	\$0	\$1,139	\$3,483	\$1,425	\$7,731
Year 4	\$1,685	\$0	\$1,139	\$3,483	\$1,425	\$7,731
Year 5	\$1,685	\$0	\$1,139	\$3,483	\$1,425	\$7,731
Year 6	\$1,685	\$0	\$1,139	\$3,483	\$1,425	\$7,731
Total	\$10,108	\$0	\$6,832	\$20,898	\$8,550	\$46,388

Revenues for Local Taxing Districts

During construction, the project will generate the following revenues for local taxing districts:

Total Revenues for Local Taxing District During Construction				
	Sales Taxes	Lodging Taxes	Other Taxes and Revenues	Total Revenues
Year 1	\$520	\$107	\$932	\$1,559
Year 2	\$520	\$110	\$960	\$1,590
Year 3	\$520	\$113	\$989	\$1,622
Year 4	\$520	\$117	\$1,018	\$1,655
Year 5	\$520	\$120	\$1,049	\$1,689
Year 6	\$520	\$124	\$1,081	\$1,724
Total	\$3,119	\$690	\$6,029	\$9,838

\$487.75

Total Revenues for the States and Local Taxing Districts

During construction, the project will generate the following total revenues for the states and local taxing districts:

Total Revenues for the States and Local Taxing Districts During Construction						
	Sales Tax Collections	Lodging Taxes	Corporate Income Taxes	Personal Income Taxes	Other Taxes and Revenues	Total
Year 1	\$2,205	\$107	\$1,139	\$3,483	\$2,357	\$9,290
Year 2	\$2,205	\$110	\$1,139	\$3,483	\$2,385	\$9,321
Year 3	\$2,205	\$113	\$1,139	\$3,483	\$2,414	\$9,353
Year 4	\$2,205	\$117	\$1,139	\$3,483	\$2,443	\$9,386
Year 5	\$2,205	\$120	\$1,139	\$3,483	\$2,474	\$9,420
Year 6	\$2,205	\$124	\$1,139	\$3,483	\$2,505	\$9,455
Total	\$13,227	\$690	\$6,832	\$20,898	\$14,579	\$56,226

Summary of Total Revenues for the States and Local Taxing Districts

During construction, the project will generate the following total revenues for the states and local taxing districts:

Summary of Annual Tax Revenues for the States and Local Taxing Districts During Construction	
States of North Dakota and Minnesota	\$2,300
Local taxing districts	\$488
Total	\$2,788

EXHIBIT D
Local and State Tax Detailed Calculations
– Operations and Maintenance Used for RED Analysis

Operations & Maintenance

Detailed Calculations for State & Local Tax Revenue

North Dakota East 35k cfs

All values are in \$1,000

Revenues for the State and Local Taxing Districts During the Project's Operations

Sales Tax to be Collected

Workers' Spending Subject to Sales Tax

An estimated 33% of the spending of direct workers and related indirect workers will be subject to sales taxes. Further, an estimated 80% of this spending will be in the Fargo-Moorhead area. If this is the case, retail sales in the area generated by workers during the project's operations will be as follows.

Taxable Retail Sales in the Area to be Generated by Workers	
Year 1	\$316
Year 2	\$316
Year 3	\$316
Year 4	\$316
Year 5	\$316
Year 6	\$316
Year 7	\$316
Year 8	\$316
Year 9	\$316
Year 10	\$316
Year 11	\$316
Year 12	\$316
Year 13	\$316
Year 14	\$316
Year 15	\$316
Year 16	\$316
Year 17	\$316
Year 18	\$316
Year 19	\$316
Year 20	\$316
Total	\$6,325

Source: Impact DataSource calculations based on estimated spending in the area

Sales Tax Collections

The states of North Dakota and Minnesota and local taxing districts will collect the following sales tax on workers' spending:

Estimated Sales Tax Collections on Workers' Spending			
	States	Local Taxing Districts	Total
Effective sales tax rate	5.33%	1.65%	
Year 1	\$17	\$5	\$22
Year 2	\$17	\$5	\$22
Year 3	\$17	\$5	\$22
Year 4	\$17	\$5	\$22
Year 5	\$17	\$5	\$22
Year 6	\$17	\$5	\$22
Year 7	\$17	\$5	\$22
Year 8	\$17	\$5	\$22
Year 9	\$17	\$5	\$22
Year 10	\$17	\$5	\$22
Year 11	\$17	\$5	\$22
Year 12	\$17	\$5	\$22
Year 13	\$17	\$5	\$22
Year 14	\$17	\$5	\$22
Year 15	\$17	\$5	\$22
Year 16	\$17	\$5	\$22
Year 17	\$17	\$5	\$22
Year 18	\$17	\$5	\$22
Year 19	\$17	\$5	\$22
Year 20	\$17	\$5	\$22
Total	\$337	\$104	\$441

Source: Sales tax rates for each state and local taxing districts obtained from each state's department of revenue or local taxing district. Effective sales tax rates, blending the tax rates of two states and several local taxing districts, were determined in calculations by Impact DataSource based on the number of business establishments in Cass and Clay Counties.

State Personal Income Taxes to be Collected

During the project's operation salaries of all direct, indirect and induced workers may be subject to North Dakota and Minnesota personal income taxes. If this is the case, the states will collect the following personal income taxes:

Estimated State Personal Income Taxes to be Collected During the Project's Operations				
	Total Direct and Indirect Workers' Payrolls	Percent of Salaries Subject to State Personal Income Tax	Effective Personal Income Tax Rate as a Percent of Total Income	Total Personal Income Tax Collections
Year 1	\$1,198	100%	2.547%	\$31
Year 2	\$1,198	100%	2.547%	\$31
Year 3	\$1,198	100%	2.547%	\$31
Year 4	\$1,198	100%	2.547%	\$31
Year 5	\$1,198	100%	2.547%	\$31
Year 6	\$1,198	100%	2.547%	\$31
Year 7	\$1,198	100%	2.547%	\$31
Year 8	\$1,198	100%	2.547%	\$31
Year 9	\$1,198	100%	2.547%	\$31
Year 10	\$1,198	100%	2.547%	\$31
Year 11	\$1,198	100%	2.547%	\$31
Year 12	\$1,198	100%	2.547%	\$31
Year 13	\$1,198	100%	2.547%	\$31
Year 14	\$1,198	100%	2.547%	\$31
Year 15	\$1,198	100%	2.547%	\$31
Year 16	\$1,198	100%	2.547%	\$31
Year 17	\$1,198	100%	2.547%	\$31
Year 18	\$1,198	100%	2.547%	\$31
Year 19	\$1,198	100%	2.547%	\$31
Year 20	\$1,198	100%	2.547%	\$31
Total	\$23,958			\$610

Source: Personal income tax rates were obtained from each state's department of revenue.

Effective state personal income tax rates, blending the tax rates North Dakota, were determined in calculations by Impact DataSource based on median household income in the area and the percentage of labor force in Cass and Clay Counties. The percent of workers whose salaries will be subject to personal income taxes in the two states are Impact DataSource estimates.

State Corporate Income Taxes to be Collected

During the project's operations, an estimated 8% of the total economic output generated by indirect businesses may be subject to North Dakota or Minnesota corporate income taxes. This analysis assumes that a public entity may operate the project and, therefore, its net income will not be subject to state corporate income taxes. If this is the case, the states will collect the following corporate income taxes during the project's operations:

Estimated Corporate Income Taxes to be Collected During the Project's Operations				
	Revenues for Indirect Businesses	Percent of Revenues Subject to State Corporate Income Tax	Effective Corporate Income Tax Rate as a Percent of Net Income	Total Corporate Income Tax Collections
Year 1	\$1,141	8%	7.003%	\$6
Year 2	\$1,141	8%	7.003%	\$6
Year 3	\$1,141	8%	7.003%	\$6
Year 4	\$1,141	8%	7.003%	\$6
Year 5	\$1,141	8%	7.003%	\$6
Year 6	\$1,141	8%	7.003%	\$6
Year 7	\$1,141	8%	7.003%	\$6
Year 8	\$1,141	8%	7.003%	\$6
Year 9	\$1,141	8%	7.003%	\$6
Year 10	\$1,141	8%	7.003%	\$6
Year 11	\$1,141	8%	7.003%	\$6
Year 12	\$1,141	8%	7.003%	\$6
Year 13	\$1,141	8%	7.003%	\$6
Year 14	\$1,141	8%	7.003%	\$6
Year 15	\$1,141	8%	7.003%	\$6
Year 16	\$1,141	8%	7.003%	\$6
Year 17	\$1,141	8%	7.003%	\$6
Year 18	\$1,141	8%	7.003%	\$6
Year 19	\$1,141	8%	7.003%	\$6
Year 20	\$1,141	8%	7.003%	\$6
Total	\$22,825			\$128

Source: Corporate income tax rates were obtained from each state's department of revenue. Effective state corporate income tax rates, blending the tax rates North Dakota, were determined in calculations by Impact DataSource based on the percentage of business establishments in Cass and Clay Counties. The percent of total business revenues that will be subject to state corporation income taxes in the two states are Impact DataSource estimates.

Other Taxes, User Fees, Charges for Services and Miscellaneous Revenues for the States and Local Taxing Districts Collected from Workers

During the project's operations, the states and local taxing districts will collect other taxes, user fees, charges for services, and miscellaneous revenues primarily from workers. These estimated annual revenues to be collected per worker are shown below:

Annual Miscellaneous Revenues Collected Per Worker	
States	\$764.41
Local taxing districts	\$500

Source: Miscellaneous revenues per worker for states calculated by Impact DataSource from information shown in the general fund budgets of each state along with the number of workers in each state. Further, miscellaneous revenues for each state were blending to obtain an average by Impact DataSource based on relative number of workers in Cass and Clay Counties. Miscellaneous revenues for local taxing districts are Impact DataSource estimates.

If these estimated miscellaneous revenues are received by the states and local taxing districts for each worker and an estimated 80% of the workers may live in the Fargo-Moorhead area, the following revenues will be received during the project's operations:

Estimated Miscellaneous Revenues for the States and Local Taxing Districts During the Project's Operations					
	Number of Workers in the States	Number of Local Workers	Miscellaneous Revenues		
			State	Local Taxing Districts	Total
Year 1	26	21	\$20	\$11	\$31
Year 2	26	21	\$20	\$11	\$31
Year 3	26	21	\$20	\$11	\$31
Year 4	26	21	\$20	\$11	\$31
Year 5	26	21	\$20	\$11	\$31
Year 6	26	21	\$20	\$11	\$31
Year 7	26	21	\$20	\$11	\$31
Year 8	26	21	\$20	\$11	\$31
Year 9	26	21	\$20	\$11	\$31
Year 10	26	21	\$20	\$11	\$31
Year 11	26	21	\$20	\$11	\$31
Year 12	26	21	\$20	\$11	\$31
Year 13	26	21	\$20	\$11	\$31
Year 14	26	21	\$20	\$11	\$31
Year 15	26	21	\$20	\$11	\$31
Year 16	26	21	\$20	\$11	\$31
Year 17	26	21	\$20	\$11	\$31
Year 18	26	21	\$20	\$11	\$31
Year 19	26	21	\$20	\$11	\$31
Year 20	26	21	\$20	\$11	\$31
Total			\$403	\$211	\$614

Source: Percent of total direct and indirect workers who may live in the Fargo-Moorhead area is an Impact DataSource estimate. Annual increases in miscellaneous of 3% are Impact DataSource estimates

Summary of Taxes and Other Revenues to be Collected by the States and Local Taxing Districts During the Project's Operations

Revenues for the States

During the project's operations, the project will generate the following revenues for the states:

Total Revenues for the States During the Project's Operations					
	Sales Taxes	Corporate Income Taxes	Personal Income Taxes	Other Taxes and Revenues	Total
Year 1	\$17	\$6	\$31	\$20	\$74
Year 2	\$17	\$6	\$31	\$20	\$74
Year 3	\$17	\$6	\$31	\$20	\$74
Year 4	\$17	\$6	\$31	\$20	\$74
Year 5	\$17	\$6	\$31	\$20	\$74
Year 6	\$17	\$6	\$31	\$20	\$74
Year 7	\$17	\$6	\$31	\$20	\$74
Year 8	\$17	\$6	\$31	\$20	\$74
Year 9	\$17	\$6	\$31	\$20	\$74
Year 10	\$17	\$6	\$31	\$20	\$74
Year 11	\$17	\$6	\$31	\$20	\$74
Year 12	\$17	\$6	\$31	\$20	\$74
Year 13	\$17	\$6	\$31	\$20	\$74
Year 14	\$17	\$6	\$31	\$20	\$74
Year 15	\$17	\$6	\$31	\$20	\$74
Year 16	\$17	\$6	\$31	\$20	\$74
Year 17	\$17	\$6	\$31	\$20	\$74
Year 18	\$17	\$6	\$31	\$20	\$74
Year 19	\$17	\$6	\$31	\$20	\$74
Year 20	\$17	\$6	\$31	\$20	\$74
Total	\$337	\$128	\$610	\$403	\$1,478

Revenues for Local Taxing Districts

During the project's operations, the project will generate the following revenues for local taxing districts:

Total Revenues for Local Taxing District During the Project's Operations			
	Sales Taxes	Other Taxes and Revenues	Total Revenues
Year 1	\$5	\$11	\$16
Year 2	\$5	\$11	\$16
Year 3	\$5	\$11	\$16
Year 4	\$5	\$11	\$16
Year 5	\$5	\$11	\$16
Year 6	\$5	\$11	\$16
Year 7	\$5	\$11	\$16
Year 8	\$5	\$11	\$16
Year 9	\$5	\$11	\$16
Year 10	\$5	\$11	\$16
Year 11	\$5	\$11	\$16
Year 12	\$5	\$11	\$16
Year 13	\$5	\$11	\$16
Year 14	\$5	\$11	\$16
Year 15	\$5	\$11	\$16
Year 16	\$5	\$11	\$16
Year 17	\$5	\$11	\$16
Year 18	\$5	\$11	\$16
Year 19	\$5	\$11	\$16
Year 20	\$5	\$11	\$16
Total	\$104	\$211	\$315

Total Revenues for the States and Local Taxing Districts

During the project's operations, the project will generate the following total revenues for the states and local taxing districts:

Total Revenues for the States and Local Taxing Districts During the Project's Operations					
	Sales Tax Collections	Corporate Income Taxes	Personal Income Taxes	Other Taxes and Revenues	Total
Year 1	\$22	\$6	\$31	\$31	\$90
Year 2	\$22	\$6	\$31	\$31	\$90
Year 3	\$22	\$6	\$31	\$31	\$90
Year 4	\$22	\$6	\$31	\$31	\$90
Year 5	\$22	\$6	\$31	\$31	\$90
Year 6	\$22	\$6	\$31	\$31	\$90
Year 7	\$22	\$6	\$31	\$31	\$90
Year 8	\$22	\$6	\$31	\$31	\$90
Year 9	\$22	\$6	\$31	\$31	\$90
Year 10	\$22	\$6	\$31	\$31	\$90
Year 11	\$22	\$6	\$31	\$31	\$90
Year 12	\$22	\$6	\$31	\$31	\$90
Year 13	\$22	\$6	\$31	\$31	\$90
Year 14	\$22	\$6	\$31	\$31	\$90
Year 15	\$22	\$6	\$31	\$31	\$90
Year 16	\$22	\$6	\$31	\$31	\$90
Year 17	\$22	\$6	\$31	\$31	\$90
Year 18	\$22	\$6	\$31	\$31	\$90
Year 19	\$22	\$6	\$31	\$31	\$90
Year 20	\$22	\$6	\$31	\$31	\$90
Total	\$441	\$128	\$610	\$614	\$1,793

Summary of Total Revenues for the States and Local Taxing Districts

During the project's operations, the project will generate the following total revenues for the states and local taxing districts:

Summary of Annual Tax Revenues for the States and Local Taxing Districts During the First Twenty Years of the Project's Operations	
States of North Dakota and Minnesota	\$74
Local taxing districts	\$16
Total	\$90

Operations & Maintenance

Detailed Calculations for State & Local Tax Revenue

Minnesota South 35k cfs

All values are in \$1,000

Revenues for the State and Local Taxing Districts During the Project's Operations

Sales Tax to be Collected

Workers' Spending Subject to Sales Tax

An estimated 33% of the spending of direct workers and related indirect workers will be subject to sales taxes. Further, an estimated 80% of this spending will be in the Fargo-Moorhead area. If this is the case, retail sales in the area generated by workers during the project's operations will be as follows.

Taxable Retail Sales in the Area to be Generated by Workers	
Year 1	\$302
Year 2	\$302
Year 3	\$302
Year 4	\$302
Year 5	\$302
Year 6	\$302
Year 7	\$302
Year 8	\$302
Year 9	\$302
Year 10	\$302
Year 11	\$302
Year 12	\$302
Year 13	\$302
Year 14	\$302
Year 15	\$302
Year 16	\$302
Year 17	\$302
Year 18	\$302
Year 19	\$302
Year 20	\$302
Total	\$6,037

Source: Impact DataSource calculations based on estimated spending in the area

Sales Tax Collections

The states of North Dakota and Minnesota and local taxing districts will collect the following sales tax on workers' spending:

Estimated Sales Tax Collections on Workers' Spending			
	States	Local Taxing Districts	Total
Effective sales tax rate	5.33%	1.65%	
Year 1	\$16	\$5	\$21
Year 2	\$16	\$5	\$21
Year 3	\$16	\$5	\$21
Year 4	\$16	\$5	\$21
Year 5	\$16	\$5	\$21
Year 6	\$16	\$5	\$21
Year 7	\$16	\$5	\$21
Year 8	\$16	\$5	\$21
Year 9	\$16	\$5	\$21
Year 10	\$16	\$5	\$21
Year 11	\$16	\$5	\$21
Year 12	\$16	\$5	\$21
Year 13	\$16	\$5	\$21
Year 14	\$16	\$5	\$21
Year 15	\$16	\$5	\$21
Year 16	\$16	\$5	\$21
Year 17	\$16	\$5	\$21
Year 18	\$16	\$5	\$21
Year 19	\$16	\$5	\$21
Year 20	\$16	\$5	\$21
Total	\$322	\$99	\$421

Source: Sales tax rates for each state and local taxing districts obtained from each state's department of revenue or local taxing district. Effective sales tax rates, blending the tax rates of two states and several local taxing districts, were determined in calculations by Impact DataSource based on the number of business establishments in Cass and Clay Counties.

State Personal Income Taxes to be Collected

During the project's operation salaries of direct, indirect and induced workers may be subject to North Dakota and Minnesota personal income taxes. If this is the case, the states will collect the following personal income taxes:

Estimated State Personal Income Taxes to be Collected During the Project's Operations				
	Total Direct and Indirect Workers' Payrolls	Percent of Salaries Subject to State Personal Income Tax	Effective Personal Income Tax Rate as a Percent of Total Income	Total Personal Income Tax Collections
Year 1	\$1,143	100%	2.547%	\$29
Year 2	\$1,143	100%	2.547%	\$29
Year 3	\$1,143	100%	2.547%	\$29
Year 4	\$1,143	100%	2.547%	\$29
Year 5	\$1,143	100%	2.547%	\$29
Year 6	\$1,143	100%	2.547%	\$29
Year 7	\$1,143	100%	2.547%	\$29
Year 8	\$1,143	100%	2.547%	\$29
Year 9	\$1,143	100%	2.547%	\$29
Year 10	\$1,143	100%	2.547%	\$29
Year 11	\$1,143	100%	2.547%	\$29
Year 12	\$1,143	100%	2.547%	\$29
Year 13	\$1,143	100%	2.547%	\$29
Year 14	\$1,143	100%	2.547%	\$29
Year 15	\$1,143	100%	2.547%	\$29
Year 16	\$1,143	100%	2.547%	\$29
Year 17	\$1,143	100%	2.547%	\$29
Year 18	\$1,143	100%	2.547%	\$29
Year 19	\$1,143	100%	2.547%	\$29
Year 20	\$1,143	100%	2.547%	\$29
Total	\$22,869			\$582

Source: Personal income tax rates were obtained from each state's department of revenue.

Effective state personal income tax rates, blending the tax rates North Dakota, were determined in calculations by Impact DataSource based on median household income in the area and the percentage of labor force in Cass and Clay Counties. The percent of workers whose salaries will be subject to personal income taxes in the two states are Impact DataSource estimates.

State Corporate Income Taxes to be Collected

During the project's operations, an estimated 8% of the total economic output generated by indirect businesses may be subject to North Dakota or Minnesota corporate income taxes. This analysis assumes that a public entity may operate the project and, therefore, its net income will not be subject to state corporate income taxes. If this is the case, the states will collect the following corporate income taxes during the project's operations:

Estimated Corporate Income Taxes to be Collected During the Project's Operations				
	Revenues for Indirect Businesses	Percent of Revenues Subject to State Corporate Income Tax	Effective Corporate Income Tax Rate as a Percent of Net Income	Total Corporate Income Tax Collections
Year 1	\$1,084	8%	7.003%	\$6
Year 2	\$1,084	8%	7.003%	\$6
Year 3	\$1,084	8%	7.003%	\$6
Year 4	\$1,084	8%	7.003%	\$6
Year 5	\$1,084	8%	7.003%	\$6
Year 6	\$1,084	8%	7.003%	\$6
Year 7	\$1,084	8%	7.003%	\$6
Year 8	\$1,084	8%	7.003%	\$6
Year 9	\$1,084	8%	7.003%	\$6
Year 10	\$1,084	8%	7.003%	\$6
Year 11	\$1,084	8%	7.003%	\$6
Year 12	\$1,084	8%	7.003%	\$6
Year 13	\$1,084	8%	7.003%	\$6
Year 14	\$1,084	8%	7.003%	\$6
Year 15	\$1,084	8%	7.003%	\$6
Year 16	\$1,084	8%	7.003%	\$6
Year 17	\$1,084	8%	7.003%	\$6
Year 18	\$1,084	8%	7.003%	\$6
Year 19	\$1,084	8%	7.003%	\$6
Year 20	\$1,084	8%	7.003%	\$6
Total	\$21,685			\$121

Source: Corporate income tax rates were obtained from each state's department of revenue. Effective state corporate income tax rates, blending the tax rates North Dakota, were determined in calculations by Impact DataSource based on the percentage of business establishments in Cass and Clay Counties. The percent of total business revenues that will be subject to state corporation income taxes in the two states are Impact DataSource estimates.

Other Taxes, User Fees, Charges for Services and Miscellaneous Revenues for the States and Local Taxing Districts Collected from Workers

During the project's operations, the states and local taxing districts will collect other taxes, user fees, charges for services, and miscellaneous revenues primarily from workers. These estimated annual revenues to be collected per worker are shown below:

Annual Miscellaneous Revenues Collected Per Worker	
States	\$764.41
Local taxing districts	\$500

Source: Miscellaneous revenues per worker for states calculated by Impact DataSource from information shown in the general fund budgets of each state along with the number of workers in each state. Further, miscellaneous revenues for each state were blending to obtain an average by Impact DataSource based on relative number of workers in Cass and Clay Counties. Miscellaneous revenues for local taxing districts are Impact DataSource estimates.

If these estimated miscellaneous revenues are received by the states and local taxing districts for each worker and an estimated 80% of the workers may live in the Fargo-Moorhead area, the following revenues will be received during the project's operations:

Estimated Miscellaneous Revenues for the States and Local Taxing Districts During the Project's Operations					
	Number of Workers in the States	Number of Local Workers	Miscellaneous Revenues		Total
			State	Local Taxing Districts	
Year 1	25	20	\$19	\$10	\$29
Year 2	25	20	\$19	\$10	\$29
Year 3	25	20	\$19	\$10	\$29
Year 4	25	20	\$19	\$10	\$29
Year 5	25	20	\$19	\$10	\$29
Year 6	25	20	\$19	\$10	\$29
Year 7	25	20	\$19	\$10	\$29
Year 8	25	20	\$19	\$10	\$29
Year 9	25	20	\$19	\$10	\$29
Year 10	25	20	\$19	\$10	\$29
Year 11	25	20	\$19	\$10	\$29
Year 12	25	20	\$19	\$10	\$29
Year 13	25	20	\$19	\$10	\$29
Year 14	25	20	\$19	\$10	\$29
Year 15	25	20	\$19	\$10	\$29
Year 16	25	20	\$19	\$10	\$29
Year 17	25	20	\$19	\$10	\$29
Year 18	25	20	\$19	\$10	\$29
Year 19	25	20	\$19	\$10	\$29
Year 20	25	20	\$19	\$10	\$29
Total			\$384	\$201	\$586

Source: Percent of total direct and indirect workers who may live in the Fargo-Moorhead area is an Impact DataSource estimate. Annual increases in miscellaneous of 3% are Impact DataSource estimates

Summary of Taxes and Other Revenues to be Collected by the States and Local Taxing Districts During the Project's Operations

Revenues for the States

During the project's operations, the project will generate the following revenues for the states:

Total Revenues for the States During the Project's Operations					
	Sales Taxes	Corporate Income Taxes	Personal Income Taxes	Other Taxes and Revenues	Total
Year 1	\$16	\$6	\$29	\$19	\$71
Year 2	\$16	\$6	\$29	\$19	\$71
Year 3	\$16	\$6	\$29	\$19	\$71
Year 4	\$16	\$6	\$29	\$19	\$71
Year 5	\$16	\$6	\$29	\$19	\$71
Year 6	\$16	\$6	\$29	\$19	\$71
Year 7	\$16	\$6	\$29	\$19	\$71
Year 8	\$16	\$6	\$29	\$19	\$71
Year 9	\$16	\$6	\$29	\$19	\$71
Year 10	\$16	\$6	\$29	\$19	\$71
Year 11	\$16	\$6	\$29	\$19	\$71
Year 12	\$16	\$6	\$29	\$19	\$71
Year 13	\$16	\$6	\$29	\$19	\$71
Year 14	\$16	\$6	\$29	\$19	\$71
Year 15	\$16	\$6	\$29	\$19	\$71
Year 16	\$16	\$6	\$29	\$19	\$71
Year 17	\$16	\$6	\$29	\$19	\$71
Year 18	\$16	\$6	\$29	\$19	\$71
Year 19	\$16	\$6	\$29	\$19	\$71
Year 20	\$16	\$6	\$29	\$19	\$71
Total	\$322	\$121	\$582	\$384	\$1,410

Revenues for Local Taxing Districts

During the project's operations, the project will generate the following revenues for local taxing districts:

Total Revenues for Local Taxing District During the Project's Operations			
	Sales Taxes	Other Taxes and Revenues	Total Revenues
Year 1	\$5	\$10	\$15
Year 2	\$5	\$10	\$15
Year 3	\$5	\$10	\$15
Year 4	\$5	\$10	\$15
Year 5	\$5	\$10	\$15
Year 6	\$5	\$10	\$15
Year 7	\$5	\$10	\$15
Year 8	\$5	\$10	\$15
Year 9	\$5	\$10	\$15
Year 10	\$5	\$10	\$15
Year 11	\$5	\$10	\$15
Year 12	\$5	\$10	\$15
Year 13	\$5	\$10	\$15
Year 14	\$5	\$10	\$15
Year 15	\$5	\$10	\$15
Year 16	\$5	\$10	\$15
Year 17	\$5	\$10	\$15
Year 18	\$5	\$10	\$15
Year 19	\$5	\$10	\$15
Year 20	\$5	\$10	\$15
Total	\$99	\$201	\$301

Total Revenues for the States and Local Taxing Districts

During the project's operations, the project will generate the following total revenues for the states and local taxing districts:

Total Revenues for the States and Local Taxing Districts During the Project's Operations					
	Sales Tax Collections	Corporate Income Taxes	Personal Income Taxes	Other Taxes and Revenues	Total
Year 1	\$21	\$6	\$29	\$29	\$86
Year 2	\$21	\$6	\$29	\$29	\$86
Year 3	\$21	\$6	\$29	\$29	\$86
Year 4	\$21	\$6	\$29	\$29	\$86
Year 5	\$21	\$6	\$29	\$29	\$86
Year 6	\$21	\$6	\$29	\$29	\$86
Year 7	\$21	\$6	\$29	\$29	\$86
Year 8	\$21	\$6	\$29	\$29	\$86
Year 9	\$21	\$6	\$29	\$29	\$86
Year 10	\$21	\$6	\$29	\$29	\$86
Year 11	\$21	\$6	\$29	\$29	\$86
Year 12	\$21	\$6	\$29	\$29	\$86
Year 13	\$21	\$6	\$29	\$29	\$86
Year 14	\$21	\$6	\$29	\$29	\$86
Year 15	\$21	\$6	\$29	\$29	\$86
Year 16	\$21	\$6	\$29	\$29	\$86
Year 17	\$21	\$6	\$29	\$29	\$86
Year 18	\$21	\$6	\$29	\$29	\$86
Year 19	\$21	\$6	\$29	\$29	\$86
Year 20	\$21	\$6	\$29	\$29	\$86
Total	\$421	\$121	\$582	\$586	\$1,711

Summary of Total Revenues for the States and Local Taxing Districts

During the project's operations, the project will generate the following total revenues for the states and local taxing districts:

Summary of Annual Tax Revenues for the States and Local Taxing Districts During the First Twenty Years of the Project's Operations	
States of North Dakota and Minnesota	\$71
Local taxing districts	\$15
Total	\$86

Operations & Maintenance

Detailed Calculations for State & Local Tax Revenue

Minnesota South 20k cfs

All values are in \$1,000

Revenues for the State and Local Taxing Districts During the Project's Operations

Sales Tax to be Collected

Workers' Spending Subject to Sales Tax

An estimated 33% of the spending of direct workers and related indirect workers will be subject to sales taxes. Further, an estimated 80% of this spending will be in the Fargo-Moorhead area. If this is the case, retail sales in the area generated by workers during the project's operations will be as follows.

Taxable Retail Sales in the Area to be Generated by Workers	
Year 1	\$230
Year 2	\$230
Year 3	\$230
Year 4	\$230
Year 5	\$230
Year 6	\$230
Year 7	\$230
Year 8	\$230
Year 9	\$230
Year 10	\$230
Year 11	\$230
Year 12	\$230
Year 13	\$230
Year 14	\$230
Year 15	\$230
Year 16	\$230
Year 17	\$230
Year 18	\$230
Year 19	\$230
Year 20	\$230
Total	\$4,600

Source: Impact DataSource calculations based on estimated spending in the area

Sales Tax Collections

The states of North Dakota and Minnesota and local taxing districts will collect the following sales tax on workers' spending:

Estimated Sales Tax Collections on Workers' Spending			
	States	Local Taxing Districts	Total
Effective sales tax rate	5.33%	1.65%	
Year 1	\$12	\$4	\$16
Year 2	\$12	\$4	\$16
Year 3	\$12	\$4	\$16
Year 4	\$12	\$4	\$16
Year 5	\$12	\$4	\$16
Year 6	\$12	\$4	\$16
Year 7	\$12	\$4	\$16
Year 8	\$12	\$4	\$16
Year 9	\$12	\$4	\$16
Year 10	\$12	\$4	\$16
Year 11	\$12	\$4	\$16
Year 12	\$12	\$4	\$16
Year 13	\$12	\$4	\$16
Year 14	\$12	\$4	\$16
Year 15	\$12	\$4	\$16
Year 16	\$12	\$4	\$16
Year 17	\$12	\$4	\$16
Year 18	\$12	\$4	\$16
Year 19	\$12	\$4	\$16
Year 20	\$12	\$4	\$16
Total	\$245	\$76	\$321

Source: Sales tax rates for each state and local taxing districts obtained from each state's department of revenue or local taxing district. Effective sales tax rates, blending the tax rates of two states and several local taxing districts, were determined in calculations by Impact DataSource based on the number of business establishments in Cass and Clay Counties.

State Personal Income Taxes to be Collected

During the project's operation salaries of direct, indirect and induced workers may be subject to North Dakota and Minnesota personal income taxes. If this is the case, the states will collect the following personal income taxes:

Estimated State Personal Income Taxes to be Collected During the Project's Operations				
	Total Direct and Indirect Workers' Payrolls	Percent of Salaries Subject to State Personal Income Tax	Effective Personal Income Tax Rate as a Percent of Total Income	Total Personal Income Tax Collections
Year 1	\$871	100%	2.547%	\$22
Year 2	\$871	100%	2.547%	\$22
Year 3	\$871	100%	2.547%	\$22
Year 4	\$871	100%	2.547%	\$22
Year 5	\$871	100%	2.547%	\$22
Year 6	\$871	100%	2.547%	\$22
Year 7	\$871	100%	2.547%	\$22
Year 8	\$871	100%	2.547%	\$22
Year 9	\$871	100%	2.547%	\$22
Year 10	\$871	100%	2.547%	\$22
Year 11	\$871	100%	2.547%	\$22
Year 12	\$871	100%	2.547%	\$22
Year 13	\$871	100%	2.547%	\$22
Year 14	\$871	100%	2.547%	\$22
Year 15	\$871	100%	2.547%	\$22
Year 16	\$871	100%	2.547%	\$22
Year 17	\$871	100%	2.547%	\$22
Year 18	\$871	100%	2.547%	\$22
Year 19	\$871	100%	2.547%	\$22
Year 20	\$871	100%	2.547%	\$22
Total	\$17,424			\$444

Source: Personal income tax rates were obtained from each state's department of revenue.

Effective state personal income tax rates, blending the tax rates North Dakota, were determined in calculations by Impact DataSource based on median household income in the area and the percentage of labor force in Cass and Clay Counties. The percent of workers whose salaries will be subject to personal income taxes in the two states are Impact DataSource estimates.

State Corporate Income Taxes to be Collected

During the project's operations, an estimated 8% of the total economic output generated by indirect businesses may be subject to North Dakota or Minnesota corporate income taxes. This analysis assumes that a public entity may operate the project and, therefore, its net income will not be subject to state corporate income taxes. If this is the case, the states will collect the following corporate income taxes during the project's operations:

Estimated Corporate Income Taxes to be Collected During the Project's Operations				
	Revenues for Indirect Businesses	Percent of Revenues Subject to State Corporate Income Tax	Effective Corporate Income Tax Rate as a Percent of Net Income	Total Corporate Income Tax Collections
Year 1	\$829	8%	7.003%	\$5
Year 2	\$829	8%	7.003%	\$5
Year 3	\$829	8%	7.003%	\$5
Year 4	\$829	8%	7.003%	\$5
Year 5	\$829	8%	7.003%	\$5
Year 6	\$829	8%	7.003%	\$5
Year 7	\$829	8%	7.003%	\$5
Year 8	\$829	8%	7.003%	\$5
Year 9	\$829	8%	7.003%	\$5
Year 10	\$829	8%	7.003%	\$5
Year 11	\$829	8%	7.003%	\$5
Year 12	\$829	8%	7.003%	\$5
Year 13	\$829	8%	7.003%	\$5
Year 14	\$829	8%	7.003%	\$5
Year 15	\$829	8%	7.003%	\$5
Year 16	\$829	8%	7.003%	\$5
Year 17	\$829	8%	7.003%	\$5
Year 18	\$829	8%	7.003%	\$5
Year 19	\$829	8%	7.003%	\$5
Year 20	\$829	8%	7.003%	\$5
Total	\$16,577			\$93

Source: Corporate income tax rates were obtained from each state's department of revenue. Effective state corporate income tax rates, blending the tax rates North Dakota, were determined in calculations by Impact DataSource based on the percentage of business establishments in Cass and Clay Counties. The percent of total business revenues that will be subject to state corporation income taxes in the two states are Impact DataSource estimates.

Other Taxes, User Fees, Charges for Services and Miscellaneous Revenues for the States and Local Taxing Districts Collected from Workers

During the project's operations, the states and local taxing districts will collect other taxes, user fees, charges for services, and miscellaneous revenues primarily from workers. These estimated annual revenues to be collected per worker are shown below:

Annual Miscellaneous Revenues Collected Per Worker	
States	\$764.41
Local taxing districts	\$500

Source: Miscellaneous revenues per worker for states calculated by Impact DataSource from information shown in the general fund budgets of each state along with the number of workers in each state. Further, miscellaneous revenues for each state were blending to obtain an average by Impact DataSource based on relative number of workers in Cass and Clay Counties. Miscellaneous revenues for local taxing districts are Impact DataSource estimates.

If these estimated miscellaneous revenues are received by the states and local taxing districts for each worker and an estimated 80% of the workers may live in the Fargo-Moorhead area, the following revenues will be received during the project's operations:

Estimated Miscellaneous Revenues for the States and Local Taxing Districts During the Project's Operations					
	Number of Workers in the States	Number of Local Workers	Miscellaneous Revenues		Total
			State	Local Taxing Districts	
Year 1	19	15	\$15	\$8	\$22
Year 2	19	15	\$15	\$8	\$22
Year 3	19	15	\$15	\$8	\$22
Year 4	19	15	\$15	\$8	\$22
Year 5	19	15	\$15	\$8	\$22
Year 6	19	15	\$15	\$8	\$22
Year 7	19	15	\$15	\$8	\$22
Year 8	19	15	\$15	\$8	\$22
Year 9	19	15	\$15	\$8	\$22
Year 10	19	15	\$15	\$8	\$22
Year 11	19	15	\$15	\$8	\$22
Year 12	19	15	\$15	\$8	\$22
Year 13	19	15	\$15	\$8	\$22
Year 14	19	15	\$15	\$8	\$22
Year 15	19	15	\$15	\$8	\$22
Year 16	19	15	\$15	\$8	\$22
Year 17	19	15	\$15	\$8	\$22
Year 18	19	15	\$15	\$8	\$22
Year 19	19	15	\$15	\$8	\$22
Year 20	19	15	\$15	\$8	\$22
Total			\$293	\$153	\$446

Source: Percent of total direct and indirect workers who may live in the Fargo-Moorhead area is an Impact DataSource estimate. Annual increases in miscellaneous of 3% are Impact DataSource estimates

Summary of Taxes and Other Revenues to be Collected by the States and Local Taxing Districts During the Project's Operations

Revenues for the States

During the project's operations, the project will generate the following revenues for the states:

Total Revenues for the States During the Project's Operations					
	Sales Taxes	Corporate Income Taxes	Personal Income Taxes	Other Taxes and Revenues	Total
Year 1	\$12	\$5	\$22	\$15	\$54
Year 2	\$12	\$5	\$22	\$15	\$54
Year 3	\$12	\$5	\$22	\$15	\$54
Year 4	\$12	\$5	\$22	\$15	\$54
Year 5	\$12	\$5	\$22	\$15	\$54
Year 6	\$12	\$5	\$22	\$15	\$54
Year 7	\$12	\$5	\$22	\$15	\$54
Year 8	\$12	\$5	\$22	\$15	\$54
Year 9	\$12	\$5	\$22	\$15	\$54
Year 10	\$12	\$5	\$22	\$15	\$54
Year 11	\$12	\$5	\$22	\$15	\$54
Year 12	\$12	\$5	\$22	\$15	\$54
Year 13	\$12	\$5	\$22	\$15	\$54
Year 14	\$12	\$5	\$22	\$15	\$54
Year 15	\$12	\$5	\$22	\$15	\$54
Year 16	\$12	\$5	\$22	\$15	\$54
Year 17	\$12	\$5	\$22	\$15	\$54
Year 18	\$12	\$5	\$22	\$15	\$54
Year 19	\$12	\$5	\$22	\$15	\$54
Year 20	\$12	\$5	\$22	\$15	\$54
Total	\$245	\$93	\$444	\$293	\$1,075

Revenues for Local Taxing Districts

During the project's operations, the project will generate the following revenues for local taxing districts:

Total Revenues for Local Taxing District During the Project's Operations			
	Sales Taxes	Other Taxes and Revenues	Total Revenues
Year 1	\$4	\$8	\$11
Year 2	\$4	\$8	\$11
Year 3	\$4	\$8	\$11
Year 4	\$4	\$8	\$11
Year 5	\$4	\$8	\$11
Year 6	\$4	\$8	\$11
Year 7	\$4	\$8	\$11
Year 8	\$4	\$8	\$11
Year 9	\$4	\$8	\$11
Year 10	\$4	\$8	\$11
Year 11	\$4	\$8	\$11
Year 12	\$4	\$8	\$11
Year 13	\$4	\$8	\$11
Year 14	\$4	\$8	\$11
Year 15	\$4	\$8	\$11
Year 16	\$4	\$8	\$11
Year 17	\$4	\$8	\$11
Year 18	\$4	\$8	\$11
Year 19	\$4	\$8	\$11
Year 20	\$4	\$8	\$11
Total	\$76	\$153	\$229

Total Revenues for the States and Local Taxing Districts

During the project's operations, the project will generate the following total revenues for the states and local taxing districts:

Total Revenues for the States and Local Taxing Districts During the Project's Operations					
	Sales Tax Collections	Corporate Income Taxes	Personal Income Taxes	Other Taxes and Revenues	Total
Year 1	\$16	\$5	\$22	\$22	\$65
Year 2	\$16	\$5	\$22	\$22	\$65
Year 3	\$16	\$5	\$22	\$22	\$65
Year 4	\$16	\$5	\$22	\$22	\$65
Year 5	\$16	\$5	\$22	\$22	\$65
Year 6	\$16	\$5	\$22	\$22	\$65
Year 7	\$16	\$5	\$22	\$22	\$65
Year 8	\$16	\$5	\$22	\$22	\$65
Year 9	\$16	\$5	\$22	\$22	\$65
Year 10	\$16	\$5	\$22	\$22	\$65
Year 11	\$16	\$5	\$22	\$22	\$65
Year 12	\$16	\$5	\$22	\$22	\$65
Year 13	\$16	\$5	\$22	\$22	\$65
Year 14	\$16	\$5	\$22	\$22	\$65
Year 15	\$16	\$5	\$22	\$22	\$65
Year 16	\$16	\$5	\$22	\$22	\$65
Year 17	\$16	\$5	\$22	\$22	\$65
Year 18	\$16	\$5	\$22	\$22	\$65
Year 19	\$16	\$5	\$22	\$22	\$65
Year 20	\$16	\$5	\$22	\$22	\$65
Total	\$321	\$93	\$444	\$446	\$1,304

Summary of Total Revenues for the States and Local Taxing Districts

During the project's operations, the project will generate the following total revenues for the states and local taxing districts:

Summary of Annual Tax Revenues for the States and Local Taxing Districts During the First Twenty Years of the Project's Operations	
States of North Dakota and Minnesota	\$54
Local taxing districts	\$11
Total	\$65

EXHIBIT E
Local and State Tax Detailed Calculations
– Avoided Flood Damages Used for RED Analysis

Avoided Flood Losses

Detailed Calculations for State & Local Tax Revenue

All values are in \$1,000

Reduction of State and Local Tax Revenue from Loss of Business Income

Assuming that 33% of earnings would have been used to purchase taxable items and workers would have made 80% of such purchases in the area, the table below calculates the reduction in States and Locals sales tax revenue.

Reduction in States and Local Sales Tax Revenue in the Fargo-Moorhead Region Due to Loss of Business Income				
	Existing Conditions	Diversion Project		
		ND E 35k	MN S 35k	MN S 20k
Reduction in Taxable Spending	\$8,419	\$0	\$0	\$0
States Sales Tax (effective sales tax rate 5.33%)	\$449	\$0	\$0	\$0
Local Sales Tax (effective sales tax rate 1.65%)	\$139	\$0	\$0	\$0

Based on workers' lost earnings, the table below calculates the loss in states personal income tax.

Reduction in States and Local Personal Income Tax Revenue in the Fargo-Moorhead Region Due to Loss of Business Income				
	Existing Conditions	Diversion Project		
		ND E 35k	MN S 35k	MN S 20k
Workers' Loss in Income	\$31,891	\$0	\$0	\$0
States Personal Income Tax (effective sales tax rate 2.55%)	\$812	\$0	\$0	\$0

Based the reduction in output, the table below calculates the loss in states corporate income tax.

Reduction in States and Local Personal Income Tax Revenue in the Fargo-Moorhead Region Due to Loss of Business Income				
	Existing Conditions	Diversion Project		
		ND E 35k	MN S 35k	MN S 20k
Reduction in Output	\$87,468	\$0	\$0	\$0
Reduction Taxable Corporate Income (assumed to be 8% of Output)	\$6,997	\$0	\$0	\$0
States Corporate Income Tax (effective corporate income tax rate 7.003%)	\$490	\$0	\$0	\$0

Based on the reduction in employment, the reduction in miscellaneous tax revenue is calculated below.

Reduction in States and Local Miscellaneous Tax Revenue in the Fargo-Moorhead Region Due to Loss of Business Income				
	Existing Conditions	Diversion Project		
		ND E 35k	MN S 35k	MN S 20k
Reduction in employment in region	913	0	0	0
States Miscellaneous Tax Revenue (\$764 per worker)	\$698	\$0	\$0	\$0
Local Miscellaneous Tax Revenue (\$500 per worker)	\$457	\$0	\$0	\$0

The table below summarizes the total loss in states and local tax revenues due to loss of business income.

Total Increase in States and Local Tax Revenue in the Fargo-Moorhead Region Due to Loss of Business Income				
	Existing Conditions	Diversion Project		
		ND E 35k	MN S 35k	MN S 20k
Reduction in States Tax Revenue	\$2,449	\$0	\$0	\$0
Reduction in Local Tax Revenue	\$595	\$0	\$0	\$0
Total Reduction in States and Local Tax Revenue	\$3,044	\$0	\$0	\$0

Increase of State and Local Tax Revenue from Reconstruction

Assuming that 33% of earnings are used to purchase taxable items and workers would have made 80% of such purchases in the area, the table below calculates the Increase in States and Locals sales tax revenue.

Increase in States and Local Sales Tax Revenue in the Fargo-Moorhead Region Due to Reconstruction				
	Existing Conditions	Diversion Project		
		ND E 35k	MN S 35k	MN S 20k
Increase in Taxable Spending	\$3,103	\$403	\$568	\$949
States Sales Tax (effective sales tax rate 5.33%)	\$165	\$21	\$30	\$51
Local Sales Tax (effective sales tax rate 1.65%)	\$51	\$7	\$9	\$16

Based on the additional earnings, the table below calculates the loss in states personal income tax.

Increase in States Personal Income Tax Revenue in the Fargo-Moorhead Region Due to Reconstruction				
	Existing Conditions	Diversion Project		
		ND E 35k	MN S 35k	MN S 20k
Increase in earnings in region	\$11,752	\$1,526	\$2,152	\$3,594
States Personal Income Tax (effective sales tax rate 2.55%)	\$299	\$39	\$55	\$92

Based the increase in output, the table below calculates the increase in states corporate income tax.

Increase in States Corporate Income Tax Revenue in the Fargo-Moorhead Region Due to Loss of Business Income				
	Existing Conditions	Diversion Project		
		ND E 35k	MN S 35k	MN S 20k
Increase in Output	\$32,233	\$4,186	\$5,902	\$9,858
Increase Taxable Corporate Income (assumed to be 8% of Output)	\$2,579	\$335	\$472	\$789
States Corporate Income Tax (effective corporate income tax rate 7.003%)	\$181	\$23	\$33	\$55

Based on the increase in employment, the increase in miscellaneous tax revenue is calculated below.

Increase in States and Local Miscellaneous Tax Revenue in the Fargo-Moorhead Region Due to Reconstruction				
	Existing Conditions	Diversion Project		
		ND E 35k	MN S 35k	MN S 20k
Increase in employment in region	337	44	62	103
States Miscellaneous Tax Revenue (\$764 per worker)	\$257	\$33	\$47	\$79
Local Miscellaneous Tax Revenue (\$500 per worker)	\$168	\$22	\$31	\$51

The table below summarizes the total increase in states and local tax revenues due to reconstruction

Total Increase in States and Local Tax Revenue in the Fargo-Moorhead Region Due to Reconstruction				
	Existing Conditions	Diversion Project		
		ND E 35k	MN S 35k	MN S 20k
Increase in States Tax Revenue	\$903	\$94	\$132	\$221
Increase in Local Tax Revenue	\$219	\$28	\$40	\$67
Total Increase in States and Local Tax Revenue	\$1,122	\$122	\$172	\$288

Summary of Changes in State and Local Tax Revenue

Total Increase in States and Local Tax Revenue in the Fargo-Moorhead Region Due to Reconstruction				
	Existing Conditions	Diversion Project		
		ND E 35k	MN S 35k	MN S 20k
Increase in States Tax Revenue	\$1,547	-\$94	-\$132	-\$221
Increase in Local Tax Revenue	\$376	-\$28	-\$40	-\$67
Total Increase in States and Local Tax Revenue	\$1,923	-\$122	-\$172	-\$288

EXHIBIT F

**Local and State Tax Detailed Calculations
– Loss of Business Confidence**

Loss of Business Confidence

Detailed Calculations for State & Local Tax Revenue

All values are in \$1,000

Economic Growth for Case 1: No Diversion, Conservative Growth

The table below translate the GDP growth into job and salary growth using RIMS II multipliers for the region for Case 1. Our projections begin in 2010.

Economic Impacts for Fargo MSA Case 1: No Diversion: Conservative Growth			
	Additional Output (MSA GDP)	Additional Employment*	Additional Earnings*
Year 1	\$134,236	1,402	\$48,943
Year 2	\$135,968	1,410	\$49,574
Year 3	\$137,722	1,418	\$50,214
Year 4	\$139,498	1,426	\$50,862
Year 5	\$141,298	1,434	\$51,518
Year 6	\$143,121	1,442	\$52,182
Year 7	\$144,967	1,450	\$52,855
Year 8	\$146,837	1,458	\$53,537
Year 9	\$148,731	1,467	\$54,228
Year 10	\$150,650	1,475	\$54,927
Year 11	\$152,593	1,483	\$55,636
Year 12	\$154,562	1,492	\$56,354
Year 13	\$156,556	1,500	\$57,081
Year 14	\$158,575	1,509	\$57,817
Year 15	\$160,621	1,517	\$58,563
Year 16	\$162,693	1,526	\$59,318
Year 17	\$164,791	1,534	\$60,084
Year 18	\$166,917	1,543	\$60,859
Year 19	\$169,070	1,552	\$61,644
Year 20	\$171,252	1,561	\$62,439

Revenues for the State and Local Taxing Districts for Case 1: No Diversion, Conservative Growth

Sales Tax to be Collected

Additional Workers' Spending Subject to Sales Tax

An estimated 33% of the spending of additional workers will be subject to sales taxes. Further, an estimated 80% of this spending will be in the Fargo-Moorhead area. If this is the case, retail sales in the area resulting from the general economic growth will be as follows:

Taxable Retail Sales in the Area to be Generated by Growth	
Year 1	\$12,921
Year 2	\$13,088
Year 3	\$13,256
Year 4	\$13,427
Year 5	\$13,601
Year 6	\$13,776
Year 7	\$13,954
Year 8	\$14,134
Year 9	\$14,316
Year 10	\$14,501
Year 11	\$14,688
Year 12	\$14,877
Year 13	\$15,069
Year 14	\$15,264
Year 15	\$15,461
Year 16	\$15,660
Year 17	\$15,862
Year 18	\$16,067
Year 19	\$16,274
Year 20	\$16,484
Total	\$292,680

Source: Impact DataSource calculations based on estimated spending in the area

Sales Tax Collections

The states of North Dakota and Minnesota and local taxing districts will collect the following sales tax on workers' spending:

Estimated Sales Tax Collections on Workers' Spending			
	States	Local Taxing Districts	Total
Effective sales tax rate	5.33%	1.65%	
Year 1	\$689	\$213	\$902
Year 2	\$698	\$215	\$913
Year 3	\$707	\$218	\$925
Year 4	\$716	\$221	\$937
Year 5	\$725	\$224	\$949
Year 6	\$735	\$227	\$961
Year 7	\$744	\$230	\$974
Year 8	\$754	\$233	\$986
Year 9	\$763	\$236	\$999
Year 10	\$773	\$239	\$1,012
Year 11	\$783	\$242	\$1,025
Year 12	\$793	\$245	\$1,038
Year 13	\$804	\$248	\$1,052
Year 14	\$814	\$251	\$1,065
Year 15	\$824	\$254	\$1,079
Year 16	\$835	\$258	\$1,093
Year 17	\$846	\$261	\$1,107
Year 18	\$857	\$264	\$1,121
Year 19	\$868	\$268	\$1,136
Year 20	\$879	\$271	\$1,150
Total	\$15,607	\$4,815	\$20,423

Source: Sales tax rates for each state and local taxing districts obtained from each state's department of revenue or local taxing district. Effective sales tax rates, blending the tax rates of two states and several local taxing districts, were determined in calculations by Impact DataSource based on the number of business establishments in Cass and Clay Counties.

State Personal Income Taxes to be Collected

As a result of the economic growth in this scenario, additional workers' salaries will be subject to North Dakota and Minnesota personal income taxes. It is projected the states will collect the following personal income taxes:

Estimated State Personal Income Taxes to be Collected				
	Additional Workers' Salaries	Percent of Salaries Subject to State Personal Income Tax	Effective Personal Income Tax Rate as a Percent of Total Income	Total Personal Income Tax Collections
Year 1	\$48,943	100%	2.547%	\$1,246
Year 2	\$49,574	100%	2.547%	\$1,262
Year 3	\$50,214	100%	2.547%	\$1,279
Year 4	\$50,862	100%	2.547%	\$1,295
Year 5	\$51,518	100%	2.547%	\$1,312
Year 6	\$52,182	100%	2.547%	\$1,329
Year 7	\$52,855	100%	2.547%	\$1,346
Year 8	\$53,537	100%	2.547%	\$1,363
Year 9	\$54,228	100%	2.547%	\$1,381
Year 10	\$54,927	100%	2.547%	\$1,399
Year 11	\$55,636	100%	2.547%	\$1,417
Year 12	\$56,354	100%	2.547%	\$1,435
Year 13	\$57,081	100%	2.547%	\$1,454
Year 14	\$57,817	100%	2.547%	\$1,472
Year 15	\$58,563	100%	2.547%	\$1,491
Year 16	\$59,318	100%	2.547%	\$1,511
Year 17	\$60,084	100%	2.547%	\$1,530
Year 18	\$60,859	100%	2.547%	\$1,550
Year 19	\$61,644	100%	2.547%	\$1,570
Year 20	\$62,439	100%	2.547%	\$1,590
Total	\$1,108,635			\$28,232

Source: Personal income tax rates were obtained from each state's department of revenue. Effective state personal income tax rates, blending the tax rates North Dakota, were determined in calculations by Impact DataSource based on median household income in the area and the percentage of labor force in Cass and Clay Counties. The percent of workers whose salaries will be subject to personal income taxes in the two states are Impact DataSource estimates.

State Corporate Income Taxes to be Collected

As a result of economic growth in this scenario, an estimated 8% of the total economic output will be subject to North Dakota or Minnesota corporate income taxes. If this is the case, the states will collect the following corporate income taxes over the next twenty years:

Estimated Corporate Income Taxes to be Collected				
	Additional Output (MSA GDP)	Percent of Revenues Subject to State Corporate Income Tax	Effective Corporate Income Tax Rate as a Percent of Net Income	Total Corporate Income Tax Collections
Year 1	\$134,236	8%	7.003%	\$752
Year 2	\$135,968	8%	7.003%	\$762
Year 3	\$137,722	8%	7.003%	\$772
Year 4	\$139,498	8%	7.003%	\$782
Year 5	\$141,298	8%	7.003%	\$792
Year 6	\$143,121	8%	7.003%	\$802
Year 7	\$144,967	8%	7.003%	\$812
Year 8	\$146,837	8%	7.003%	\$823
Year 9	\$148,731	8%	7.003%	\$833
Year 10	\$150,650	8%	7.003%	\$844
Year 11	\$152,593	8%	7.003%	\$855
Year 12	\$154,562	8%	7.003%	\$866
Year 13	\$156,556	8%	7.003%	\$877
Year 14	\$158,575	8%	7.003%	\$888
Year 15	\$160,621	8%	7.003%	\$900
Year 16	\$162,693	8%	7.003%	\$911
Year 17	\$164,791	8%	7.003%	\$923
Year 18	\$166,917	8%	7.003%	\$935
Year 19	\$169,070	8%	7.003%	\$947
Year 20	\$171,252	8%	7.003%	\$959
Total	\$3,040,658			\$17,035

Source: Corporate income tax rates were obtained from each state's department of revenue. Effective state corporate income tax rates, blending the tax rates North Dakota, were determined in calculations by Impact DataSource based on the percentage of business establishments in Cass and Clay Counties. The percent of total business revenues that will be subject to state corporation income taxes in the two states are Impact DataSource estimates.

Other Taxes, User Fees, Charges for Services and Miscellaneous Revenues for the States and Local Taxing Districts Collected from Workers

Over the next twenty years, the states and local taxing districts will collect other taxes, user fees, charges for services, and miscellaneous revenues primarily from workers. These estimated annual revenues to be collected per worker are shown below:

Annual Miscellaneous Revenues Collected Per Worker	
States	\$764.41
Local taxing districts	\$500

Source: Miscellaneous revenues per worker for states calculated by Impact DataSource from information shown in the general fund budgets of each state along with the number of workers in each state. Further, miscellaneous revenues for each state were blending to obtain an average by Impact DataSource based on relative number of workers in Cass and Clay Counties. Miscellaneous revenues for local taxing districts are Impact DataSource estimates.

If these estimated miscellaneous revenues are received by the states and local taxing districts for each additional worker under this scenario, the following revenues will be received:

Estimated Miscellaneous Revenues for the States and Local Taxing Districts				
	Number of Local Workers	Miscellaneous Revenues		Total
		State	Local Taxing Districts	
Year 1	1,402	\$1,071	\$701	\$1,772
Year 2	1,410	\$1,110	\$726	\$1,836
Year 3	1,418	\$1,150	\$752	\$1,902
Year 4	1,426	\$1,191	\$779	\$1,970
Year 5	1,434	\$1,233	\$807	\$2,040
Year 6	1,442	\$1,278	\$836	\$2,113
Year 7	1,450	\$1,323	\$866	\$2,189
Year 8	1,458	\$1,371	\$897	\$2,268
Year 9	1,467	\$1,420	\$929	\$2,349
Year 10	1,475	\$1,471	\$962	\$2,433
Year 11	1,483	\$1,524	\$997	\$2,520
Year 12	1,492	\$1,578	\$1,032	\$2,611
Year 13	1,500	\$1,635	\$1,069	\$2,704
Year 14	1,509	\$1,694	\$1,108	\$2,801
Year 15	1,517	\$1,754	\$1,147	\$2,902
Year 16	1,526	\$1,817	\$1,189	\$3,006
Year 17	1,534	\$1,882	\$1,231	\$3,113
Year 18	1,543	\$1,950	\$1,275	\$3,225
Year 19	1,552	\$2,020	\$1,321	\$3,341
Year 20	1,561	\$2,092	\$1,368	\$3,460
Total		\$30,563	\$19,992	\$50,555

Source: Percent of total direct and indirect workers who may live in the Fargo-Moorhead area is an Impact DataSource estimate. Annual increases in miscellaneous of 3% are Impact DataSource estimates

Summary of Taxes and Other Revenues to be Collected by the States and Local Taxing Districts for Case 1

Revenues for the States

The table below summarizes the projected revenues for states under Case 1.

Total Revenues for the States for Case 1: No Diversion, Conservative Growth					
	Sales Taxes	Corporate Income Taxes	Personal Income Taxes	Other Taxes and Revenues	Total
Year 1	\$689	\$752	\$1,246	\$1,071	\$3,759
Year 2	\$698	\$762	\$1,262	\$1,110	\$3,832
Year 3	\$707	\$772	\$1,279	\$1,150	\$3,907
Year 4	\$716	\$782	\$1,295	\$1,191	\$3,984
Year 5	\$725	\$792	\$1,312	\$1,233	\$4,062
Year 6	\$735	\$802	\$1,329	\$1,278	\$4,143
Year 7	\$744	\$812	\$1,346	\$1,323	\$4,226
Year 8	\$754	\$823	\$1,363	\$1,371	\$4,311
Year 9	\$763	\$833	\$1,381	\$1,420	\$4,398
Year 10	\$773	\$844	\$1,399	\$1,471	\$4,487
Year 11	\$783	\$855	\$1,417	\$1,524	\$4,579
Year 12	\$793	\$866	\$1,435	\$1,578	\$4,673
Year 13	\$804	\$877	\$1,454	\$1,635	\$4,769
Year 14	\$814	\$888	\$1,472	\$1,694	\$4,868
Year 15	\$824	\$900	\$1,491	\$1,754	\$4,970
Year 16	\$835	\$911	\$1,511	\$1,817	\$5,074
Year 17	\$846	\$923	\$1,530	\$1,882	\$5,181
Year 18	\$857	\$935	\$1,550	\$1,950	\$5,291
Year 19	\$868	\$947	\$1,570	\$2,020	\$5,404
Year 20	\$879	\$959	\$1,590	\$2,092	\$5,520
Total	\$15,607	\$17,035	\$28,232	\$30,563	\$91,438

Revenues for Local Taxing Districts

The table below summarizes the projected revenues for local taxing districts under Case 1.

Total Revenues for Local Taxing Districts for Case 1: No Diversion, Conservative Growth			
	Sales Taxes	Other Taxes and Revenues	Total Revenues
Year 1	\$213	\$701	\$913
Year 2	\$215	\$726	\$941
Year 3	\$218	\$752	\$970
Year 4	\$221	\$779	\$1,000
Year 5	\$224	\$807	\$1,031
Year 6	\$227	\$836	\$1,062
Year 7	\$230	\$866	\$1,095
Year 8	\$233	\$897	\$1,129
Year 9	\$236	\$929	\$1,164
Year 10	\$239	\$962	\$1,201
Year 11	\$242	\$997	\$1,238
Year 12	\$245	\$1,032	\$1,277
Year 13	\$248	\$1,069	\$1,317
Year 14	\$251	\$1,108	\$1,359
Year 15	\$254	\$1,147	\$1,402
Year 16	\$258	\$1,189	\$1,446
Year 17	\$261	\$1,231	\$1,492
Year 18	\$264	\$1,275	\$1,540
Year 19	\$268	\$1,321	\$1,589
Year 20	\$271	\$1,368	\$1,640
Total	\$4,815	\$19,992	\$24,807

Total Revenues for the States and Local Taxing Districts

The table below summarizes the increase in total revenues for the states and local taxing districts under Case 1.

Total Revenues for the States and Local Taxing Districts for Case 1: No Diversion, Conservative Growth					
	Sales Tax Collections	Corporate Income Taxes	Personal Income Taxes	Other Taxes and Revenues	Total
Year 1	\$902	\$752	\$1,246	\$1,772	\$4,672
Year 2	\$913	\$762	\$1,262	\$1,836	\$4,773
Year 3	\$925	\$772	\$1,279	\$1,902	\$4,877
Year 4	\$937	\$782	\$1,295	\$1,970	\$4,983
Year 5	\$949	\$792	\$1,312	\$2,040	\$5,093
Year 6	\$961	\$802	\$1,329	\$2,113	\$5,205
Year 7	\$974	\$812	\$1,346	\$2,189	\$5,321
Year 8	\$986	\$823	\$1,363	\$2,268	\$5,440
Year 9	\$999	\$833	\$1,381	\$2,349	\$5,562
Year 10	\$1,012	\$844	\$1,399	\$2,433	\$5,688
Year 11	\$1,025	\$855	\$1,417	\$2,520	\$5,817
Year 12	\$1,038	\$866	\$1,435	\$2,611	\$5,950
Year 13	\$1,052	\$877	\$1,454	\$2,704	\$6,086
Year 14	\$1,065	\$888	\$1,472	\$2,801	\$6,227
Year 15	\$1,079	\$900	\$1,491	\$2,902	\$6,372
Year 16	\$1,093	\$911	\$1,511	\$3,006	\$6,520
Year 17	\$1,107	\$923	\$1,530	\$3,113	\$6,674
Year 18	\$1,121	\$935	\$1,550	\$3,225	\$6,831
Year 19	\$1,136	\$947	\$1,570	\$3,341	\$6,993
Year 20	\$1,150	\$959	\$1,590	\$3,460	\$7,160
Total	\$20,423	\$17,035	\$28,232	\$50,555	\$116,245

Summary of Total Revenues for the States and Local Taxing Districts

The following total revenues for the states and local taxing districts over the next 20 years of projected growth are shown below for Case 1.

Summary of Total Revenues for the States and Local Taxing Districts Under Case 1: No Diversion, Conservative Growth	
States of North Dakota and Minnesota	\$91,438
Local taxing districts	\$24,807
Total	\$116,245

Economic Growth for Case 2: No Diversion, Moderate Growth

The table below translates the GDP growth into job and salary growth using RIMS II multipliers for the region for Case 2. We assume the projections in this analysis begin in 2010.

Economic Impacts for Fargo MSA Case 2: No Diversion, Moderate Growth			
	Additional Output (MSA GDP)	Additional Employment	Additional Earnings
Year 1	\$226,849	2,250	\$82,710
Year 2	\$231,794	2,272	\$84,513
Year 3	\$236,847	2,294	\$86,355
Year 4	\$242,010	2,316	\$88,238
Year 5	\$247,286	2,338	\$90,161
Year 6	\$252,677	2,360	\$92,127
Year 7	\$258,185	2,383	\$94,135
Year 8	\$263,814	2,406	\$96,187
Year 9	\$269,565	2,429	\$98,284
Year 10	\$275,442	2,452	\$100,427
Year 11	\$281,446	2,476	\$102,616
Year 12	\$287,582	2,499	\$104,853
Year 13	\$293,851	2,523	\$107,139
Year 14	\$300,257	2,547	\$109,475
Year 15	\$306,803	2,572	\$111,861
Year 16	\$313,491	2,597	\$114,300
Year 17	\$320,325	2,621	\$116,792
Year 18	\$327,308	2,647	\$119,338
Year 19	\$334,443	2,672	\$121,939
Year 20	\$341,734	2,698	\$124,597

Revenues for the State and Local Taxing Districts for Case 2: No Diversion, Moderate Growth

Sales Tax to be Collected

Additional Workers' Spending Subject to Sales Tax

An estimated 33% of the spending of additional workers will be subject to sales taxes. Further, an estimated 80% of this spending will be in the Fargo-Moorhead area. If this is the case, retail sales in the area resulting from the general economic growth will be as follows:

Taxable Retail Sales in the Area to be Generated by Growth	
Year 1	\$21,835
Year 2	\$22,311
Year 3	\$22,798
Year 4	\$23,295
Year 5	\$23,803
Year 6	\$24,322
Year 7	\$24,852
Year 8	\$25,393
Year 9	\$25,947
Year 10	\$26,513
Year 11	\$27,091
Year 12	\$27,681
Year 13	\$28,285
Year 14	\$28,901
Year 15	\$29,531
Year 16	\$30,175
Year 17	\$30,833
Year 18	\$31,505
Year 19	\$32,192
Year 20	\$32,894
Total	\$540,157

Source: Impact DataSource calculations based on estimated spending in the area

Sales Tax Collections

The states of North Dakota and Minnesota and local taxing districts will collect the following sales tax on workers' spending:

Estimated Sales Tax Collections on Workers' Spending			
	States	Local Taxing Districts	Total
Effective sales tax rate	5.33%	1.65%	
Year 1	\$1,164	\$359	\$1,524
Year 2	\$1,190	\$367	\$1,557
Year 3	\$1,216	\$375	\$1,591
Year 4	\$1,242	\$383	\$1,625
Year 5	\$1,269	\$392	\$1,661
Year 6	\$1,297	\$400	\$1,697
Year 7	\$1,325	\$409	\$1,734
Year 8	\$1,354	\$418	\$1,772
Year 9	\$1,384	\$427	\$1,811
Year 10	\$1,414	\$436	\$1,850
Year 11	\$1,445	\$446	\$1,890
Year 12	\$1,476	\$455	\$1,932
Year 13	\$1,508	\$465	\$1,974
Year 14	\$1,541	\$476	\$2,017
Year 15	\$1,575	\$486	\$2,061
Year 16	\$1,609	\$496	\$2,106
Year 17	\$1,644	\$507	\$2,151
Year 18	\$1,680	\$518	\$2,198
Year 19	\$1,717	\$530	\$2,246
Year 20	\$1,754	\$541	\$2,295
Total	\$28,804	\$8,887	\$37,691

Source: Sales tax rates for each state and local taxing districts obtained from each state's department of revenue or local taxing district. Effective sales tax rates, blending the tax rates of two states and several local taxing districts, were determined in calculations by Impact DataSource based on the number of business establishments in Cass and Clay Counties.

State Personal Income Taxes to be Collected

As a result of the economic growth in this scenario, additional workers' salaries will be subject to North Dakota and Minnesota personal income taxes. It is projected the states will collect the following personal income taxes:

Estimated State Personal Income Taxes to be Collected				
	Additional Workers' Salaries	Percent of Salaries Subject to State Personal Income Tax	Effective Personal Income Tax Rate as a Percent of Total Income	Total Personal Income Tax Collections
Year 1	\$82,710	100%	2.547%	\$2,106
Year 2	\$84,513	100%	2.547%	\$2,152
Year 3	\$86,355	100%	2.547%	\$2,199
Year 4	\$88,238	100%	2.547%	\$2,247
Year 5	\$90,161	100%	2.547%	\$2,296
Year 6	\$92,127	100%	2.547%	\$2,346
Year 7	\$94,135	100%	2.547%	\$2,397
Year 8	\$96,187	100%	2.547%	\$2,449
Year 9	\$98,284	100%	2.547%	\$2,503
Year 10	\$100,427	100%	2.547%	\$2,557
Year 11	\$102,616	100%	2.547%	\$2,613
Year 12	\$104,853	100%	2.547%	\$2,670
Year 13	\$107,139	100%	2.547%	\$2,728
Year 14	\$109,475	100%	2.547%	\$2,788
Year 15	\$111,861	100%	2.547%	\$2,849
Year 16	\$114,300	100%	2.547%	\$2,911
Year 17	\$116,792	100%	2.547%	\$2,974
Year 18	\$119,338	100%	2.547%	\$3,039
Year 19	\$121,939	100%	2.547%	\$3,105
Year 20	\$124,597	100%	2.547%	\$3,173
Total	\$2,046,049			\$52,104

Source: Personal income tax rates were obtained from each state's department of revenue.

Effective state personal income tax rates, blending the tax rates North Dakota, were determined in calculations by Impact DataSource based on median household income in the area and the percentage of labor force in Cass and Clay Counties. The percent of workers whose salaries will be subject to personal income taxes in the two states are Impact DataSource estimates.

State Corporate Income Taxes to be Collected

As a result of economic growth in this scenario, an estimated 8% of the total economic output will be subject to North Dakota or Minnesota corporate income taxes. If this is the case, the states will collect the following corporate income taxes over the next twenty years:

Estimated Corporate Income Taxes to be Collected				
	Additional Output (MSA GDP)	Percent of Revenues Subject to State Corporate Income Tax	Effective Corporate Income Tax Rate as a Percent of Net Income	Total Corporate Income Tax Collections
Year 1	\$226,849	8%	7.003%	\$1,271
Year 2	\$231,794	8%	7.003%	\$1,299
Year 3	\$236,847	8%	7.003%	\$1,327
Year 4	\$242,010	8%	7.003%	\$1,356
Year 5	\$247,286	8%	7.003%	\$1,385
Year 6	\$252,677	8%	7.003%	\$1,416
Year 7	\$258,185	8%	7.003%	\$1,446
Year 8	\$263,814	8%	7.003%	\$1,478
Year 9	\$269,565	8%	7.003%	\$1,510
Year 10	\$275,442	8%	7.003%	\$1,543
Year 11	\$281,446	8%	7.003%	\$1,577
Year 12	\$287,582	8%	7.003%	\$1,611
Year 13	\$293,851	8%	7.003%	\$1,646
Year 14	\$300,257	8%	7.003%	\$1,682
Year 15	\$306,803	8%	7.003%	\$1,719
Year 16	\$313,491	8%	7.003%	\$1,756
Year 17	\$320,325	8%	7.003%	\$1,795
Year 18	\$327,308	8%	7.003%	\$1,834
Year 19	\$334,443	8%	7.003%	\$1,874
Year 20	\$341,734	8%	7.003%	\$1,915
Total	\$5,611,709			\$31,439

Source: Corporate income tax rates were obtained from each state's department of revenue. Effective state corporate income tax rates, blending the tax rates North Dakota, were determined in calculations by Impact DataSource based on the percentage of business establishments in Cass and Clay Counties. The percent of total business revenues that will be subject to state corporation income taxes in the two states are Impact DataSource estimates.

Other Taxes, User Fees, Charges for Services and Miscellaneous Revenues for the States and Local Taxing Districts Collected from Workers

Over the next twenty years, the states and local taxing districts will collect other taxes, user fees, charges for services, and miscellaneous revenues primarily from workers. These estimated annual revenues to be collected per worker are shown below:

Annual Miscellaneous Revenues Collected Per Worker	
States	\$764.41
Local taxing districts	\$500

Source: Miscellaneous revenues per worker for states calculated by Impact DataSource from information shown in the general fund budgets of each state along with the number of workers in each state. Further, miscellaneous revenues for each state were blending to obtain an average by Impact DataSource based on relative number of workers in Cass and Clay Counties. Miscellaneous revenues for local taxing districts are Impact DataSource estimates.

If these estimated miscellaneous revenues are received by the states and local taxing districts for each additional worker under this scenario, the following revenues will be received:

Estimated Miscellaneous Revenues for the States and Local Taxing Districts				
	Number of Local Workers	Miscellaneous Revenues		Total
		State	Local Taxing Districts	
Year 1	2,250	\$1,720	\$1,125	\$2,845
Year 2	2,272	\$1,789	\$1,170	\$2,959
Year 3	2,294	\$1,860	\$1,217	\$3,077
Year 4	2,316	\$1,934	\$1,265	\$3,199
Year 5	2,338	\$2,011	\$1,316	\$3,327
Year 6	2,360	\$2,091	\$1,368	\$3,460
Year 7	2,383	\$2,175	\$1,423	\$3,597
Year 8	2,406	\$2,262	\$1,479	\$3,741
Year 9	2,429	\$2,352	\$1,538	\$3,890
Year 10	2,452	\$2,446	\$1,600	\$4,045
Year 11	2,476	\$2,543	\$1,663	\$4,207
Year 12	2,499	\$2,645	\$1,730	\$4,374
Year 13	2,523	\$2,750	\$1,799	\$4,549
Year 14	2,547	\$2,860	\$1,871	\$4,730
Year 15	2,572	\$2,974	\$1,945	\$4,919
Year 16	2,597	\$3,092	\$2,023	\$5,115
Year 17	2,621	\$3,216	\$2,103	\$5,319
Year 18	2,647	\$3,344	\$2,187	\$5,531
Year 19	2,672	\$3,477	\$2,274	\$5,752
Year 20	2,698	\$3,616	\$2,365	\$5,981
Total		\$51,156	\$33,461	\$84,616

Source: Percent of total direct and indirect workers who may live in the Fargo-Moorhead area is an Impact DataSource estimate. Annual increases in miscellaneous of 3% are Impact DataSource estimates

Summary of Taxes and Other Revenues to be Collected by the States and Local Taxing Districts for Case 2

Revenues for the States

The table below summarizes the projected revenues for states under Case 2.

Total Revenues for the States for Case 2: No Diversion, Moderate Growth					
	Sales Taxes	Corporate Income Taxes	Personal Income Taxes	Other Taxes and Revenues	Total
Year 1	\$1,164	\$1,271	\$2,106	\$1,720	\$6,262
Year 2	\$1,190	\$1,299	\$2,152	\$1,789	\$6,429
Year 3	\$1,216	\$1,327	\$2,199	\$1,860	\$6,602
Year 4	\$1,242	\$1,356	\$2,247	\$1,934	\$6,779
Year 5	\$1,269	\$1,385	\$2,296	\$2,011	\$6,962
Year 6	\$1,297	\$1,416	\$2,346	\$2,091	\$7,150
Year 7	\$1,325	\$1,446	\$2,397	\$2,175	\$7,344
Year 8	\$1,354	\$1,478	\$2,449	\$2,262	\$7,543
Year 9	\$1,384	\$1,510	\$2,503	\$2,352	\$7,749
Year 10	\$1,414	\$1,543	\$2,557	\$2,446	\$7,960
Year 11	\$1,445	\$1,577	\$2,613	\$2,543	\$8,178
Year 12	\$1,476	\$1,611	\$2,670	\$2,645	\$8,402
Year 13	\$1,508	\$1,646	\$2,728	\$2,750	\$8,633
Year 14	\$1,541	\$1,682	\$2,788	\$2,860	\$8,871
Year 15	\$1,575	\$1,719	\$2,849	\$2,974	\$9,116
Year 16	\$1,609	\$1,756	\$2,911	\$3,092	\$9,368
Year 17	\$1,644	\$1,795	\$2,974	\$3,216	\$9,629
Year 18	\$1,680	\$1,834	\$3,039	\$3,344	\$9,897
Year 19	\$1,717	\$1,874	\$3,105	\$3,477	\$10,173
Year 20	\$1,754	\$1,915	\$3,173	\$3,616	\$10,457
Total	\$28,804	\$31,439	\$52,104	\$51,156	\$163,503

Revenues for Local Taxing Districts

The table below summarizes the projected revenues for local taxing districts under Case 2.

Total Revenues for Local Taxing Districts for Case 2: No Diversion, Moderate Growth			
	Sales Taxes	Other Taxes and Revenues	Total Revenues
Year 1	\$359	\$1,125	\$1,484
Year 2	\$367	\$1,170	\$1,537
Year 3	\$375	\$1,217	\$1,592
Year 4	\$383	\$1,265	\$1,648
Year 5	\$392	\$1,316	\$1,707
Year 6	\$400	\$1,368	\$1,768
Year 7	\$409	\$1,423	\$1,831
Year 8	\$418	\$1,479	\$1,897
Year 9	\$427	\$1,538	\$1,965
Year 10	\$436	\$1,600	\$2,036
Year 11	\$446	\$1,663	\$2,109
Year 12	\$455	\$1,730	\$2,185
Year 13	\$465	\$1,799	\$2,264
Year 14	\$476	\$1,871	\$2,346
Year 15	\$486	\$1,945	\$2,431
Year 16	\$496	\$2,023	\$2,519
Year 17	\$507	\$2,103	\$2,611
Year 18	\$518	\$2,187	\$2,706
Year 19	\$530	\$2,274	\$2,804
Year 20	\$541	\$2,365	\$2,906
Total	\$8,887	\$33,461	\$42,348

Total Revenues for the States and Local Taxing Districts

The table below summarizes the increase in total revenues for the states and local taxing districts under Case 2.

Total Revenues for the States and Local Taxing Districts for Case 2: No Diversion, Moderate Growth					
	Sales Tax Collections	Corporate Income Taxes	Personal Income Taxes	Other Taxes and Revenues	Total
Year 1	\$1,524	\$1,271	\$2,106	\$2,845	\$7,746
Year 2	\$1,557	\$1,299	\$2,152	\$2,959	\$7,966
Year 3	\$1,591	\$1,327	\$2,199	\$3,077	\$8,193
Year 4	\$1,625	\$1,356	\$2,247	\$3,199	\$8,428
Year 5	\$1,661	\$1,385	\$2,296	\$3,327	\$8,669
Year 6	\$1,697	\$1,416	\$2,346	\$3,460	\$8,918
Year 7	\$1,734	\$1,446	\$2,397	\$3,597	\$9,175
Year 8	\$1,772	\$1,478	\$2,449	\$3,741	\$9,440
Year 9	\$1,811	\$1,510	\$2,503	\$3,890	\$9,714
Year 10	\$1,850	\$1,543	\$2,557	\$4,045	\$9,996
Year 11	\$1,890	\$1,577	\$2,613	\$4,207	\$10,287
Year 12	\$1,932	\$1,611	\$2,670	\$4,374	\$10,587
Year 13	\$1,974	\$1,646	\$2,728	\$4,549	\$10,897
Year 14	\$2,017	\$1,682	\$2,788	\$4,730	\$11,217
Year 15	\$2,061	\$1,719	\$2,849	\$4,919	\$11,547
Year 16	\$2,106	\$1,756	\$2,911	\$5,115	\$11,888
Year 17	\$2,151	\$1,795	\$2,974	\$5,319	\$12,239
Year 18	\$2,198	\$1,834	\$3,039	\$5,531	\$12,602
Year 19	\$2,246	\$1,874	\$3,105	\$5,752	\$12,977
Year 20	\$2,295	\$1,915	\$3,173	\$5,981	\$13,364
Total	\$37,691	\$31,439	\$52,104	\$84,616	\$205,851

Summary of Total Revenues for the States and Local Taxing Districts

The following total revenues for the states and local taxing districts over the next 20 years of projected growth are shown below for Case 2.

Summary of Total Revenues for the States and Local Taxing Districts Under Case 2: No Diversion, Moderate Growth	
States of North Dakota and Minnesota	\$163,503
Local taxing districts	\$42,348
Total	\$205,851

Economic Growth for Case 3: With Diversion, Conservative Growth

The table below translates the GDP growth into job and salary growth using RIMS II multipliers for the region for Case 3. Our projections in this analysis begin in 2010.

Economic Impacts for Fargo MSA Case 3: With Diversion, Conservative Growth			
	Additional Output (MSA GDP)	Additional Employment	Additional Earnings
Year 1	\$321,542	2,854	\$117,236
Year 2	\$331,478	2,893	\$120,858
Year 3	\$341,721	2,932	\$124,593
Year 4	\$352,280	2,972	\$128,443
Year 5	\$363,165	3,012	\$132,411
Year 6	\$374,387	3,053	\$136,503
Year 7	\$385,956	3,095	\$140,721
Year 8	\$397,882	3,137	\$145,069
Year 9	\$410,176	3,179	\$149,552
Year 10	\$422,851	3,222	\$154,173
Year 11	\$435,917	3,266	\$158,937
Year 12	\$449,387	3,311	\$163,848
Year 13	\$463,273	3,356	\$168,911
Year 14	\$477,588	3,401	\$174,130
Year 15	\$492,345	3,448	\$179,511
Year 16	\$507,559	3,494	\$185,058
Year 17	\$523,242	3,542	\$190,776
Year 18	\$539,411	3,590	\$196,671
Year 19	\$556,078	3,639	\$202,748
Year 20	\$573,261	3,688	\$209,013

Revenues for the State and Local Taxing Districts for Case 3: With Diversion, Conservative Growth

Sales Tax to be Collected

Additional Workers' Spending Subject to Sales Tax

An estimated 33% of the spending of additional workers will be subject to sales taxes. Further, an estimated 80% of this spending will be in the Fargo-Moorhead area. If this is the case, retail sales in the area resulting from the general economic growth will be as follows:

Taxable Retail Sales in the Area to be Generated by Growth	
Year 1	\$30,950
Year 2	\$31,907
Year 3	\$32,892
Year 4	\$33,909
Year 5	\$34,957
Year 6	\$36,037
Year 7	\$37,150
Year 8	\$38,298
Year 9	\$39,482
Year 10	\$40,702
Year 11	\$41,959
Year 12	\$43,256
Year 13	\$44,592
Year 14	\$45,970
Year 15	\$47,391
Year 16	\$48,855
Year 17	\$50,365
Year 18	\$51,921
Year 19	\$53,526
Year 20	\$55,179
Total	\$839,298

Source: Impact DataSource calculations based on estimated spending in the area

Sales Tax Collections

The states of North Dakota and Minnesota and local taxing districts will collect the following sales tax on workers' spending:

Estimated Sales Tax Collections on Workers' Spending			
	States	Local Taxing Districts	Total
Effective sales tax rate	5.33%	1.65%	
Year 1	\$1,650	\$509	\$2,160
Year 2	\$1,701	\$525	\$2,226
Year 3	\$1,754	\$541	\$2,295
Year 4	\$1,808	\$558	\$2,366
Year 5	\$1,864	\$575	\$2,439
Year 6	\$1,922	\$593	\$2,515
Year 7	\$1,981	\$611	\$2,592
Year 8	\$2,042	\$630	\$2,672
Year 9	\$2,105	\$650	\$2,755
Year 10	\$2,170	\$670	\$2,840
Year 11	\$2,237	\$690	\$2,928
Year 12	\$2,307	\$712	\$3,018
Year 13	\$2,378	\$734	\$3,112
Year 14	\$2,451	\$756	\$3,208
Year 15	\$2,527	\$780	\$3,307
Year 16	\$2,605	\$804	\$3,409
Year 17	\$2,686	\$829	\$3,514
Year 18	\$2,769	\$854	\$3,623
Year 19	\$2,854	\$881	\$3,735
Year 20	\$2,942	\$908	\$3,850
Total	\$44,756	\$13,809	\$58,565

Source: Sales tax rates for each state and local taxing districts obtained from each state's department of revenue or local taxing district. Effective sales tax rates, blending the tax rates of two states and several local taxing districts, were determined in calculations by Impact DataSource based on the number of business establishments in Cass and Clay Counties.

State Personal Income Taxes to be Collected

As a result of the economic growth in this scenario, additional workers' salaries will be subject to North Dakota and Minnesota personal income taxes. It is projected the states will collect the following personal income taxes:

Estimated State Personal Income Taxes to be Collected				
	Additional Workers' Salaries	Percent of Salaries Subject to State Personal Income Tax	Effective Personal Income Tax Rate as a Percent of Total Income	Total Personal Income Tax Collections
Year 1	\$117,236	100%	2.547%	\$2,986
Year 2	\$120,858	100%	2.547%	\$3,078
Year 3	\$124,593	100%	2.547%	\$3,173
Year 4	\$128,443	100%	2.547%	\$3,271
Year 5	\$132,411	100%	2.547%	\$3,372
Year 6	\$136,503	100%	2.547%	\$3,476
Year 7	\$140,721	100%	2.547%	\$3,584
Year 8	\$145,069	100%	2.547%	\$3,694
Year 9	\$149,552	100%	2.547%	\$3,808
Year 10	\$154,173	100%	2.547%	\$3,926
Year 11	\$158,937	100%	2.547%	\$4,047
Year 12	\$163,848	100%	2.547%	\$4,173
Year 13	\$168,911	100%	2.547%	\$4,301
Year 14	\$174,130	100%	2.547%	\$4,434
Year 15	\$179,511	100%	2.547%	\$4,571
Year 16	\$185,058	100%	2.547%	\$4,713
Year 17	\$190,776	100%	2.547%	\$4,858
Year 18	\$196,671	100%	2.547%	\$5,008
Year 19	\$202,748	100%	2.547%	\$5,163
Year 20	\$209,013	100%	2.547%	\$5,323
Total	\$3,179,161			\$80,960

Source: Personal income tax rates were obtained from each state's department of revenue.

Effective state personal income tax rates, blending the tax rates North Dakota, were determined in calculations by Impact DataSource based on median household income in the area and the percentage of labor force in Cass and Clay Counties. The percent of workers whose salaries will be subject to personal income taxes in the two states are Impact DataSource estimates.

State Corporate Income Taxes to be Collected

As a result of economic growth in this scenario, an estimated 8% of the total economic output will be subject to North Dakota or Minnesota corporate income taxes. If this is the case, the states will collect the following corporate income taxes over the next twenty years:

Estimated Corporate Income Taxes to be Collected				
	Additional Output (MSA GDP)	Percent of Revenues Subject to State Corporate Income Tax	Effective Corporate Income Tax Rate as a Percent of Net Income	Total Corporate Income Tax Collections
Year 1	\$321,542	8%	7.003%	\$1,801
Year 2	\$331,478	8%	7.003%	\$1,857
Year 3	\$341,721	8%	7.003%	\$1,914
Year 4	\$352,280	8%	7.003%	\$1,974
Year 5	\$363,165	8%	7.003%	\$2,035
Year 6	\$374,387	8%	7.003%	\$2,097
Year 7	\$385,956	8%	7.003%	\$2,162
Year 8	\$397,882	8%	7.003%	\$2,229
Year 9	\$410,176	8%	7.003%	\$2,298
Year 10	\$422,851	8%	7.003%	\$2,369
Year 11	\$435,917	8%	7.003%	\$2,442
Year 12	\$449,387	8%	7.003%	\$2,518
Year 13	\$463,273	8%	7.003%	\$2,595
Year 14	\$477,588	8%	7.003%	\$2,676
Year 15	\$492,345	8%	7.003%	\$2,758
Year 16	\$507,559	8%	7.003%	\$2,844
Year 17	\$523,242	8%	7.003%	\$2,931
Year 18	\$539,411	8%	7.003%	\$3,022
Year 19	\$556,078	8%	7.003%	\$3,115
Year 20	\$573,261	8%	7.003%	\$3,212
Total	\$8,719,500			\$48,850

Source: Corporate income tax rates were obtained from each state's department of revenue. Effective state corporate income tax rates, blending the tax rates North Dakota, were determined in calculations by Impact DataSource based on the percentage of business establishments in Cass and Clay Counties. The percent of total business revenues that will be subject to state corporation income taxes in the two states are Impact DataSource estimates.

Other Taxes, User Fees, Charges for Services and Miscellaneous Revenues for the States and Local Taxing Districts Collected from Workers

Over the next twenty years, the states and local taxing districts will collect other taxes, user fees, charges for services, and miscellaneous revenues primarily from workers. These estimated annual revenues to be collected per worker are shown below:

Annual Miscellaneous Revenues Collected Per Worker	
States	\$764.41
Local taxing districts	\$500

Source: Miscellaneous revenues per worker for states calculated by Impact DataSource from information shown in the general fund budgets of each state along with the number of workers in each state. Further, miscellaneous revenues for each state were blending to obtain an average by Impact DataSource based on relative number of workers in Cass and Clay Counties. Miscellaneous revenues for local taxing districts are Impact DataSource estimates.

If these estimated miscellaneous revenues are received by the states and local taxing districts for each additional worker under this scenario, the following revenues will be received:

Estimated Miscellaneous Revenues for the States and Local Taxing Districts				
	Number of Local Workers	Miscellaneous Revenues		Total
		State	Local Taxing Districts	
Year 1	2,854	\$2,181	\$1,427	\$3,608
Year 2	2,893	\$2,277	\$1,490	\$3,767
Year 3	2,932	\$2,378	\$1,555	\$3,933
Year 4	2,972	\$2,482	\$1,624	\$4,106
Year 5	3,012	\$2,591	\$1,695	\$4,287
Year 6	3,053	\$2,705	\$1,770	\$4,475
Year 7	3,095	\$2,825	\$1,848	\$4,672
Year 8	3,137	\$2,949	\$1,929	\$4,878
Year 9	3,179	\$3,079	\$2,014	\$5,092
Year 10	3,222	\$3,214	\$2,102	\$5,316
Year 11	3,266	\$3,355	\$2,195	\$5,550
Year 12	3,311	\$3,503	\$2,291	\$5,795
Year 13	3,356	\$3,657	\$2,392	\$6,050
Year 14	3,401	\$3,818	\$2,498	\$6,316
Year 15	3,448	\$3,986	\$2,607	\$6,594
Year 16	3,494	\$4,162	\$2,722	\$6,884
Year 17	3,542	\$4,345	\$2,842	\$7,187
Year 18	3,590	\$4,536	\$2,967	\$7,503
Year 19	3,639	\$4,736	\$3,098	\$7,833
Year 20	3,688	\$4,944	\$3,234	\$8,178
Total		\$67,724	\$44,298	\$112,022

Source: Percent of total direct and indirect workers who may live in the Fargo-Moorhead area is an Impact DataSource estimate. Annual increases in miscellaneous of 3% are Impact DataSource estimates

Summary of Taxes and Other Revenues to be Collected by the States and Local Taxing Districts for Case 3

Revenues for the States

The table below summarizes the projected revenues for states under Case 3.

Total Revenues for the States for Case 3: With Diversion, Conservative Growth					
	Sales Taxes	Corporate Income Taxes	Personal Income Taxes	Other Taxes and Revenues	Total
Year 1	\$1,650	\$1,801	\$2,986	\$2,181	\$8,619
Year 2	\$1,701	\$1,857	\$3,078	\$2,277	\$8,914
Year 3	\$1,754	\$1,914	\$3,173	\$2,378	\$9,219
Year 4	\$1,808	\$1,974	\$3,271	\$2,482	\$9,535
Year 5	\$1,864	\$2,035	\$3,372	\$2,591	\$9,862
Year 6	\$1,922	\$2,097	\$3,476	\$2,705	\$10,201
Year 7	\$1,981	\$2,162	\$3,584	\$2,825	\$10,551
Year 8	\$2,042	\$2,229	\$3,694	\$2,949	\$10,915
Year 9	\$2,105	\$2,298	\$3,808	\$3,079	\$11,290
Year 10	\$2,170	\$2,369	\$3,926	\$3,214	\$11,680
Year 11	\$2,237	\$2,442	\$4,047	\$3,355	\$12,083
Year 12	\$2,307	\$2,518	\$4,173	\$3,503	\$12,500
Year 13	\$2,378	\$2,595	\$4,301	\$3,657	\$12,932
Year 14	\$2,451	\$2,676	\$4,434	\$3,818	\$13,380
Year 15	\$2,527	\$2,758	\$4,571	\$3,986	\$13,843
Year 16	\$2,605	\$2,844	\$4,713	\$4,162	\$14,323
Year 17	\$2,686	\$2,931	\$4,858	\$4,345	\$14,820
Year 18	\$2,769	\$3,022	\$5,008	\$4,536	\$15,335
Year 19	\$2,854	\$3,115	\$5,163	\$4,736	\$15,868
Year 20	\$2,942	\$3,212	\$5,323	\$4,944	\$16,421
Total	\$44,756	\$48,850	\$80,960	\$67,724	\$242,290

Revenues for Local Taxing Districts

The table below summarizes the projected revenues for local taxing districts under Case 3.

Total Revenues for Local Taxing Districts for Case 3: With Diversion, Conservative Growth			
	Sales Taxes	Other Taxes and Revenues	Total Revenues
Year 1	\$509	\$1,427	\$1,936
Year 2	\$525	\$1,490	\$2,015
Year 3	\$541	\$1,555	\$2,096
Year 4	\$558	\$1,624	\$2,182
Year 5	\$575	\$1,695	\$2,270
Year 6	\$593	\$1,770	\$2,363
Year 7	\$611	\$1,848	\$2,459
Year 8	\$630	\$1,929	\$2,559
Year 9	\$650	\$2,014	\$2,663
Year 10	\$670	\$2,102	\$2,772
Year 11	\$690	\$2,195	\$2,885
Year 12	\$712	\$2,291	\$3,003
Year 13	\$734	\$2,392	\$3,126
Year 14	\$756	\$2,498	\$3,254
Year 15	\$780	\$2,607	\$3,387
Year 16	\$804	\$2,722	\$3,526
Year 17	\$829	\$2,842	\$3,671
Year 18	\$854	\$2,967	\$3,821
Year 19	\$881	\$3,098	\$3,978
Year 20	\$908	\$3,234	\$4,142
Total	\$13,809	\$44,298	\$58,107

Total Revenues for the States and Local Taxing Districts

The table below summarizes the increase in total revenues for the states and local taxing districts under Case 3.

Total Revenues for the States and Local Taxing Districts for Case 3: With Diversion, Conservative Growth					
	Sales Tax Collections	Corporate Income Taxes	Personal Income Taxes	Other Taxes and Revenues	Total
Year 1	\$2,160	\$1,801	\$2,986	\$3,608	\$10,555
Year 2	\$2,226	\$1,857	\$3,078	\$3,767	\$10,928
Year 3	\$2,295	\$1,914	\$3,173	\$3,933	\$11,315
Year 4	\$2,366	\$1,974	\$3,271	\$4,106	\$11,716
Year 5	\$2,439	\$2,035	\$3,372	\$4,287	\$12,132
Year 6	\$2,515	\$2,097	\$3,476	\$4,475	\$12,563
Year 7	\$2,592	\$2,162	\$3,584	\$4,672	\$13,010
Year 8	\$2,672	\$2,229	\$3,694	\$4,878	\$13,473
Year 9	\$2,755	\$2,298	\$3,808	\$5,092	\$13,954
Year 10	\$2,840	\$2,369	\$3,926	\$5,316	\$14,452
Year 11	\$2,928	\$2,442	\$4,047	\$5,550	\$14,968
Year 12	\$3,018	\$2,518	\$4,173	\$5,795	\$15,503
Year 13	\$3,112	\$2,595	\$4,301	\$6,050	\$16,058
Year 14	\$3,208	\$2,676	\$4,434	\$6,316	\$16,633
Year 15	\$3,307	\$2,758	\$4,571	\$6,594	\$17,230
Year 16	\$3,409	\$2,844	\$4,713	\$6,884	\$17,849
Year 17	\$3,514	\$2,931	\$4,858	\$7,187	\$18,491
Year 18	\$3,623	\$3,022	\$5,008	\$7,503	\$19,156
Year 19	\$3,735	\$3,115	\$5,163	\$7,833	\$19,847
Year 20	\$3,850	\$3,212	\$5,323	\$8,178	\$20,562
Total	\$58,565	\$48,850	\$80,960	\$112,022	\$300,397

Summary of Total Revenues for the States and Local Taxing Districts

The following total revenues for the states and local taxing districts over the next 20 years of projected growth are shown below for Case 3.

Summary of Total Revenues for the States and Local Taxing Districts Under Case 3: With Diversion, Conservative Growth	
States of North Dakota and Minnesota	\$242,290
Local taxing districts	\$58,107
Total	\$300,397

Economic Growth for Case 4: With Diversion, Moderate Growth

The table below translates the GDP growth into job and salary growth using RIMS II multipliers for the region for Case 4. The projections in this analysis begin in 2010.

Economic Impacts for Fargo MSA Case 4: With Diversion, Moderate Growth			
	Additional Output (MSA GDP)	Additional Employment	Additional Earnings
Year 1	\$427,683	3,349	\$155,935
Year 2	\$445,260	3,410	\$162,344
Year 3	\$463,561	3,471	\$169,016
Year 4	\$482,613	3,534	\$175,962
Year 5	\$502,448	3,598	\$183,194
Year 6	\$523,099	3,663	\$190,724
Year 7	\$544,598	3,729	\$198,563
Year 8	\$566,981	3,797	\$206,723
Year 9	\$590,284	3,865	\$215,220
Year 10	\$614,545	3,935	\$224,065
Year 11	\$639,803	4,007	\$233,274
Year 12	\$666,099	4,079	\$242,862
Year 13	\$693,475	4,153	\$252,844
Year 14	\$721,977	4,228	\$263,235
Year 15	\$751,650	4,304	\$274,054
Year 16	\$782,543	4,382	\$285,318
Year 17	\$814,706	4,461	\$297,045
Year 18	\$848,190	4,542	\$309,253
Year 19	\$883,051	4,624	\$321,963
Year 20	\$919,344	4,708	\$335,196

Revenues for the State and Local Taxing Districts for Case 4: With Diversion, Moderate Growth

Sales Tax to be Collected

Additional Workers' Spending Subject to Sales Tax

An estimated 33% of the spending of additional workers will be subject to sales taxes. Further, an estimated 80% of this spending will be in the Fargo-Moorhead area. If this is the case, retail sales in the area resulting from the general economic growth will be as follows:

Taxable Retail Sales in the Area to be Generated by Growth	
Year 1	\$41,167
Year 2	\$42,859
Year 3	\$44,620
Year 4	\$46,454
Year 5	\$48,363
Year 6	\$50,351
Year 7	\$52,421
Year 8	\$54,575
Year 9	\$56,818
Year 10	\$59,153
Year 11	\$61,584
Year 12	\$64,116
Year 13	\$66,751
Year 14	\$69,494
Year 15	\$72,350
Year 16	\$75,324
Year 17	\$78,420
Year 18	\$81,643
Year 19	\$84,998
Year 20	\$88,492
Total	\$1,239,953

Source: Impact DataSource calculations based on estimated spending in the area

Sales Tax Collections

The states of North Dakota and Minnesota and local taxing districts will collect the following sales tax on workers' spending:

Estimated Sales Tax Collections on Workers' Spending			
	States	Local Taxing Districts	Total
Effective sales tax rate	5.33%	1.65%	
Year 1	\$2,195	\$677	\$2,873
Year 2	\$2,285	\$705	\$2,991
Year 3	\$2,379	\$734	\$3,114
Year 4	\$2,477	\$764	\$3,241
Year 5	\$2,579	\$796	\$3,375
Year 6	\$2,685	\$828	\$3,513
Year 7	\$2,795	\$862	\$3,658
Year 8	\$2,910	\$898	\$3,808
Year 9	\$3,030	\$935	\$3,965
Year 10	\$3,154	\$973	\$4,128
Year 11	\$3,284	\$1,013	\$4,297
Year 12	\$3,419	\$1,055	\$4,474
Year 13	\$3,560	\$1,098	\$4,658
Year 14	\$3,706	\$1,143	\$4,849
Year 15	\$3,858	\$1,190	\$5,048
Year 16	\$4,017	\$1,239	\$5,256
Year 17	\$4,182	\$1,290	\$5,472
Year 18	\$4,354	\$1,343	\$5,697
Year 19	\$4,533	\$1,398	\$5,931
Year 20	\$4,719	\$1,456	\$6,175
Total	\$66,121	\$20,401	\$86,522

Source: Sales tax rates for each state and local taxing districts obtained from each state's department of revenue or local taxing district. Effective sales tax rates, blending the tax rates of two states and several local taxing districts, were determined in calculations by Impact DataSource based on the number of business establishments in Cass and Clay Counties.

State Personal Income Taxes to be Collected

As a result of the economic growth in this scenario, additional workers' salaries will be subject to North Dakota and Minnesota personal income taxes. It is projected the states will collect the following personal income taxes:

Estimated State Personal Income Taxes to be Collected				
	Additional Workers' Salaries	Percent of Salaries Subject to State Personal Income Tax	Effective Personal Income Tax Rate as a Percent of Total Income	Total Personal Income Tax Collections
Year 1	\$155,935	100%	2.547%	\$3,971
Year 2	\$162,344	100%	2.547%	\$4,134
Year 3	\$169,016	100%	2.547%	\$4,304
Year 4	\$175,962	100%	2.547%	\$4,481
Year 5	\$183,194	100%	2.547%	\$4,665
Year 6	\$190,724	100%	2.547%	\$4,857
Year 7	\$198,563	100%	2.547%	\$5,057
Year 8	\$206,723	100%	2.547%	\$5,264
Year 9	\$215,220	100%	2.547%	\$5,481
Year 10	\$224,065	100%	2.547%	\$5,706
Year 11	\$233,274	100%	2.547%	\$5,941
Year 12	\$242,862	100%	2.547%	\$6,185
Year 13	\$252,844	100%	2.547%	\$6,439
Year 14	\$263,235	100%	2.547%	\$6,704
Year 15	\$274,054	100%	2.547%	\$6,979
Year 16	\$285,318	100%	2.547%	\$7,266
Year 17	\$297,045	100%	2.547%	\$7,564
Year 18	\$309,253	100%	2.547%	\$7,875
Year 19	\$321,963	100%	2.547%	\$8,199
Year 20	\$335,196	100%	2.547%	\$8,536
Total	\$4,696,791			\$119,608

Source: Personal income tax rates were obtained from each state's department of revenue.

Effective state personal income tax rates, blending the tax rates North Dakota, were determined in calculations by Impact DataSource based on median household income in the area and the percentage of labor force in Cass and Clay Counties. The percent of workers whose salaries will be subject to personal income taxes in the two states are Impact DataSource estimates.

State Corporate Income Taxes to be Collected

As a result of economic growth in this scenario, an estimated 8% of the total economic output will be subject to North Dakota or Minnesota corporate income taxes. If this is the case, the states will collect the following corporate income taxes over the next twenty years:

Estimated Corporate Income Taxes to be Collected				
	Additional Output (MSA GDP)	Percent of Revenues Subject to State Corporate Income Tax	Effective Corporate Income Tax Rate as a Percent of Net Income	Total Corporate Income Tax Collections
Year 1	\$427,683	8%	7.003%	\$2,396
Year 2	\$445,260	8%	7.003%	\$2,495
Year 3	\$463,561	8%	7.003%	\$2,597
Year 4	\$482,613	8%	7.003%	\$2,704
Year 5	\$502,448	8%	7.003%	\$2,815
Year 6	\$523,099	8%	7.003%	\$2,931
Year 7	\$544,598	8%	7.003%	\$3,051
Year 8	\$566,981	8%	7.003%	\$3,176
Year 9	\$590,284	8%	7.003%	\$3,307
Year 10	\$614,545	8%	7.003%	\$3,443
Year 11	\$639,803	8%	7.003%	\$3,584
Year 12	\$666,099	8%	7.003%	\$3,732
Year 13	\$693,475	8%	7.003%	\$3,885
Year 14	\$721,977	8%	7.003%	\$4,045
Year 15	\$751,650	8%	7.003%	\$4,211
Year 16	\$782,543	8%	7.003%	\$4,384
Year 17	\$814,706	8%	7.003%	\$4,564
Year 18	\$848,190	8%	7.003%	\$4,752
Year 19	\$883,051	8%	7.003%	\$4,947
Year 20	\$919,344	8%	7.003%	\$5,151
Total	\$12,881,912			\$72,170

Source: Corporate income tax rates were obtained from each state's department of revenue. Effective state corporate income tax rates, blending the tax rates North Dakota, were determined in calculations by Impact DataSource based on the percentage of business establishments in Cass and Clay Counties. The percent of total business revenues that will be subject to state corporation income taxes in the two states are Impact DataSource estimates.

Other Taxes, User Fees, Charges for Services and Miscellaneous Revenues for the States and Local Taxing Districts Collected from Workers

Over the next twenty years, the states and local taxing districts will collect other taxes, user fees, charges for services, and miscellaneous revenues primarily from workers. These estimated annual revenues to be collected per worker are shown below:

Annual Miscellaneous Revenues Collected Per Worker	
States	\$764.41
Local taxing districts	\$500

Source: Miscellaneous revenues per worker for states calculated by Impact DataSource from information shown in the general fund budgets of each state along with the number of workers in each state. Further, miscellaneous revenues for each state were blending to obtain an average by Impact DataSource based on relative number of workers in Cass and Clay Counties. Miscellaneous revenues for local taxing districts are Impact DataSource estimates.

If these estimated miscellaneous revenues are received by the states and local taxing districts for each additional worker under this scenario, the following revenues will be received:

Estimated Miscellaneous Revenues for the States and Local Taxing Districts				
	Number of Local Workers	Miscellaneous Revenues		Total
		State	Local Taxing Districts	
Year 1	3,349	\$2,560	\$1,675	\$4,235
Year 2	3,410	\$2,685	\$1,756	\$4,441
Year 3	3,471	\$2,815	\$1,841	\$4,657
Year 4	3,534	\$2,952	\$1,931	\$4,883
Year 5	3,598	\$3,096	\$2,025	\$5,120
Year 6	3,663	\$3,246	\$2,123	\$5,369
Year 7	3,729	\$3,404	\$2,227	\$5,631
Year 8	3,797	\$3,569	\$2,335	\$5,904
Year 9	3,865	\$3,743	\$2,448	\$6,191
Year 10	3,935	\$3,925	\$2,567	\$6,492
Year 11	4,007	\$4,116	\$2,692	\$6,808
Year 12	4,079	\$4,316	\$2,823	\$7,139
Year 13	4,153	\$4,526	\$2,960	\$7,486
Year 14	4,228	\$4,746	\$3,104	\$7,850
Year 15	4,304	\$4,977	\$3,255	\$8,232
Year 16	4,382	\$5,219	\$3,414	\$8,632
Year 17	4,461	\$5,473	\$3,580	\$9,052
Year 18	4,542	\$5,739	\$3,754	\$9,492
Year 19	4,624	\$6,018	\$3,936	\$9,954
Year 20	4,708	\$6,310	\$4,128	\$10,438
Total		\$83,434	\$54,574	\$138,009

Source: Percent of total direct and indirect workers who may live in the Fargo-Moorhead area is an Impact DataSource estimate. Annual increases in miscellaneous of 3% are Impact DataSource estimates

Summary of Taxes and Other Revenues to be Collected by the States and Local Taxing Districts for Case 4

Revenues for the States

The table below summarizes the projected revenues for states under Case 4.

Total Revenues for the States for Case 4: With Diversion, Moderate Growth					
	Sales Taxes	Corporate Income Taxes	Personal Income Taxes	Other Taxes and Revenues	Total
Year 1	\$2,195	\$2,396	\$3,971	\$2,560	\$11,122
Year 2	\$2,285	\$2,495	\$4,134	\$2,685	\$11,599
Year 3	\$2,379	\$2,597	\$4,304	\$2,815	\$12,096
Year 4	\$2,477	\$2,704	\$4,481	\$2,952	\$12,614
Year 5	\$2,579	\$2,815	\$4,665	\$3,096	\$13,155
Year 6	\$2,685	\$2,931	\$4,857	\$3,246	\$13,719
Year 7	\$2,795	\$3,051	\$5,057	\$3,404	\$14,307
Year 8	\$2,910	\$3,176	\$5,264	\$3,569	\$14,921
Year 9	\$3,030	\$3,307	\$5,481	\$3,743	\$15,561
Year 10	\$3,154	\$3,443	\$5,706	\$3,925	\$16,228
Year 11	\$3,284	\$3,584	\$5,941	\$4,116	\$16,925
Year 12	\$3,419	\$3,732	\$6,185	\$4,316	\$17,652
Year 13	\$3,560	\$3,885	\$6,439	\$4,526	\$18,409
Year 14	\$3,706	\$4,045	\$6,704	\$4,746	\$19,200
Year 15	\$3,858	\$4,211	\$6,979	\$4,977	\$20,025
Year 16	\$4,017	\$4,384	\$7,266	\$5,219	\$20,885
Year 17	\$4,182	\$4,564	\$7,564	\$5,473	\$21,783
Year 18	\$4,354	\$4,752	\$7,875	\$5,739	\$22,720
Year 19	\$4,533	\$4,947	\$8,199	\$6,018	\$23,697
Year 20	\$4,719	\$5,151	\$8,536	\$6,310	\$24,716
Total	\$66,121	\$72,170	\$119,608	\$83,434	\$341,333

Revenues for Local Taxing Districts

The table below summarizes the projected revenues for local taxing districts under Case 4.

Total Revenues for Local Taxing Districts for Case 4: With Diversion, Moderate Growth			
	Sales Taxes	Other Taxes and Revenues	Total Revenues
Year 1	\$677	\$1,675	\$2,352
Year 2	\$705	\$1,756	\$2,461
Year 3	\$734	\$1,841	\$2,576
Year 4	\$764	\$1,931	\$2,695
Year 5	\$796	\$2,025	\$2,821
Year 6	\$828	\$2,123	\$2,952
Year 7	\$862	\$2,227	\$3,089
Year 8	\$898	\$2,335	\$3,233
Year 9	\$935	\$2,448	\$3,383
Year 10	\$973	\$2,567	\$3,541
Year 11	\$1,013	\$2,692	\$3,705
Year 12	\$1,055	\$2,823	\$3,878
Year 13	\$1,098	\$2,960	\$4,059
Year 14	\$1,143	\$3,104	\$4,248
Year 15	\$1,190	\$3,255	\$4,446
Year 16	\$1,239	\$3,414	\$4,653
Year 17	\$1,290	\$3,580	\$4,870
Year 18	\$1,343	\$3,754	\$5,097
Year 19	\$1,398	\$3,936	\$5,335
Year 20	\$1,456	\$4,128	\$5,584
Total	\$20,401	\$54,574	\$74,975

Total Revenues for the States and Local Taxing Districts

The table below summarizes the increase in total revenues for the states and local taxing districts under Case 4.

Total Revenues for the States and Local Taxing Districts for Case 4: With Diversion, Moderate Growth					
	Sales Tax Collections	Corporate Income Taxes	Personal Income Taxes	Other Taxes and Revenues	Total
Year 1	\$2,873	\$2,396	\$3,971	\$4,235	\$13,474
Year 2	\$2,991	\$2,495	\$4,134	\$4,441	\$14,060
Year 3	\$3,114	\$2,597	\$4,304	\$4,657	\$14,671
Year 4	\$3,241	\$2,704	\$4,481	\$4,883	\$15,309
Year 5	\$3,375	\$2,815	\$4,665	\$5,120	\$15,975
Year 6	\$3,513	\$2,931	\$4,857	\$5,369	\$16,670
Year 7	\$3,658	\$3,051	\$5,057	\$5,631	\$17,396
Year 8	\$3,808	\$3,176	\$5,264	\$5,904	\$18,153
Year 9	\$3,965	\$3,307	\$5,481	\$6,191	\$18,944
Year 10	\$4,128	\$3,443	\$5,706	\$6,492	\$19,769
Year 11	\$4,297	\$3,584	\$5,941	\$6,808	\$20,630
Year 12	\$4,474	\$3,732	\$6,185	\$7,139	\$21,530
Year 13	\$4,658	\$3,885	\$6,439	\$7,486	\$22,468
Year 14	\$4,849	\$4,045	\$6,704	\$7,850	\$23,448
Year 15	\$5,048	\$4,211	\$6,979	\$8,232	\$24,471
Year 16	\$5,256	\$4,384	\$7,266	\$8,632	\$25,538
Year 17	\$5,472	\$4,564	\$7,564	\$9,052	\$26,653
Year 18	\$5,697	\$4,752	\$7,875	\$9,492	\$27,817
Year 19	\$5,931	\$4,947	\$8,199	\$9,954	\$29,031
Year 20	\$6,175	\$5,151	\$8,536	\$10,438	\$30,299
Total	\$86,522	\$72,170	\$119,608	\$138,009	\$416,308

Summary of Total Revenues for the States and Local Taxing Districts

The following total revenues for the states and local taxing districts over the next 20 years of projected growth are shown below for Case 4.

Summary of Total Revenues for the States and Local Taxing Districts Under Case 4: With Diversion, Moderate Growth	
States of North Dakota and Minnesota	\$341,333
Local taxing districts	\$74,975
Total	\$416,308

EXHIBIT G

**Phase IV Frequency-Stage-Damage Curves by Reach for Existing Conditions
(2011)**

Exhibit G contains stage-damage relationships for each reach in the study area under existing conditions. Existing conditions are conditions present in the year 2011, prior to any significant changes in economic, hydrologic, or hydraulic changes. The only exception is for projects that will be completed in then near term, such as the Oakport Levee and other flood risk management projects currently in design or construction phases. A discussion of projects that have been included in existing conditions can be found in Appendix C under Without-Project Conditions.

Damages are displayed for Subtotaled for each category into three broader categories:

Res & Apt	Total of Residential and Apartment Categories
Com&Farm	Total of Commercial, Agricultural, Farm, and CropStorage Categories
Pub&College	Total of Public and College Categories

Damages for Transportation, Sewer&Infrastructure, and Emergency Cost damages are presented in a separate reach

All values are given in October 2011 Price Levels - in \$1,000's

The stages shown are the water surface elevation in feet above see level (NAVD88) and are referenced at the index hydraulic cross section of the reach.

Delineation of reaches can be found in Exhibits I and J.

FDA Stream Name	RRN	Vertical Datum:	NAVD88		
FDA Reach	Fargo North End	Price Level:	Oct_2011		
Reach Index Location	442.93				
Exceedance	Damage by Damage Categories (\$000)				
<u>Probability</u>	<u>Stage</u>	<u>Res & Apt</u>	<u>Com&Farm</u>	<u>Pub&College</u>	<u>Total Damage</u>
0.1	893.6	6,878.1	3,684.9	312.1	10,875.0
0.05	895.8	52,433.0	28,090.4	2,379.2	82,902.5
0.02	897.8	131,120.0	70,246.2	5,949.7	207,315.9
0.01	899.1	180,962.8	96,948.6	8,211.4	286,122.8
0.005	900.4	231,997.1	124,289.8	10,527.1	366,814.0
0.002	902.0	298,598.3	159,970.8	13,549.2	472,118.3

FDA Stream Name	RRN	Vertical Datum:	NAVD88		
FDA Reach	Ridgewood	Price Level:	Oct_2011		
Reach Index Location	447.78				
Exceedance	Damage by Damage Categories (\$000)				
<u>Probability</u>	<u>Stage</u>	<u>Res & Apt</u>	<u>Com&Farm</u>	<u>Pub&College</u>	<u>Total Damage</u>
0.1	894.9	-	-	-	-
0.05	897.3	-	-	-	-
0.02	899.7	45,296.5	121,761.0	21,963.7	189,021.2
0.01	901.1	77,705.9	208,880.4	37,678.6	324,264.9
0.005	902.4	106,636.4	286,647.7	51,706.6	444,990.7
0.002	904.2	127,344.7	342,313.5	61,747.7	531,405.8

FDA Stream Name	RRN	Vertical Datum:	NAVD88		
FDA Reach	Near North	Price Level:	Oct_2011		
Reach Index Location	449.61				
Exceedance	Damage by Damage Categories (\$000)				
<u>Probability</u>	<u>Stage</u>	<u>Res & Apt</u>	<u>Com&Farm</u>	<u>Pub&College</u>	<u>Total Damage</u>
0.1	895.9	2,560.6	4,925.2	1,069.0	8,554.9
0.05	898.5	17,206.8	33,096.3	7,183.4	57,486.4
0.02	901.2	107,001.4	205,810.8	44,670.1	357,482.2
0.01	902.7	188,771.0	363,090.1	78,806.7	630,667.8
0.005	904.3	255,959.9	492,324.4	106,856.1	855,140.4
0.002	906.3	324,170.1	623,521.9	135,332.3	1,083,024.3

FDA Stream Name	RRN	Vertical Datum:	NAVD88		
FDA Reach	Downtown North	Price Level:	Oct_2011		
Reach Index Location	451.37				
Exceedance	Damage by Damage Categories (\$000)				
<u>Probability</u>	<u>Stage</u>	<u>Res & Apt</u>	<u>Com&Farm</u>	<u>Pub&College</u>	<u>Total Damage</u>
0.1	896.7	316.3	4,873.5	768.0	5,957.8
0.05	899.5	964.3	14,856.9	2,341.2	18,162.5
0.02	902.4	6,238.3	96,108.4	15,145.2	117,491.8
0.01	904.1	16,288.4	250,944.1	39,545.0	306,777.4
0.005	906.0	24,339.1	374,976.6	59,090.5	458,406.2
0.002	908.0	29,410.5	453,106.0	71,402.7	553,919.1

FDA Stream Name	RRN	Vertical Datum:	NAVD88		
FDA Reach	Downtown South	Price Level:	Oct_2011		
Reach Index Location	452.25				
Exceedance	Damage by Damage Categories (\$000)				
<u>Probability</u>	<u>Stage</u>	<u>Res & Apt</u>	<u>Com&Farm</u>	<u>Pub&College</u>	<u>Total Damage</u>
0.1	897.6	-	-	-	-
0.05	900.5	-	-	-	-
0.02	903.7	93,414.8	127,933.8	8,712.1	230,060.7
0.01	905.6	209,449.2	286,846.0	19,533.8	515,829.0
0.005	907.7	286,196.7	391,954.5	26,691.5	704,842.7
0.002	909.9	342,196.0	468,646.5	31,914.2	842,756.7

FDA Stream Name	RRN	Vertical Datum:	NAVD88		
FDA Reach	Near South	Price Level:	Oct_2011		
Reach Index Location	452.7				
Exceedance	Damage by Damage Categories (\$000)				
<u>Probability</u>	<u>Stage</u>	<u>Res & Apt</u>	<u>Com&Farm</u>	<u>Pub&College</u>	<u>Total Damage</u>
0.1	897.8	-	-	-	-
0.05	900.8	-	-	-	-
0.02	904.0	32,251.8	66,100.7	3,714.4	102,066.9
0.01	905.9	119,353.2	244,617.0	13,745.7	377,715.9
0.005	908.0	168,114.5	344,555.0	19,361.5	532,031.0
0.002	910.3	213,358.3	437,283.0	24,572.1	675,213.4

FDA Stream Name	RRN	Vertical Datum:	NAVD88		
FDA Reach	Lindenwood Area	Price Level:	Oct_2011		
Reach Index Location	454.1				
Exceedance	Damage by Damage Categories (\$000)				
<u>Probability</u>	<u>Stage</u>	<u>Res & Apt</u>	<u>Com&Farm</u>	<u>Pub&College</u>	<u>Total Damage</u>
0.1	898.3	246.7	393.1	22.8	662.6
0.05	901.3	4,206.6	6,702.0	388.1	11,296.6
0.02	904.6	124,023.6	197,595.7	11,441.8	333,061.1
0.01	906.6	222,926.8	355,169.4	20,566.1	598,662.3
0.005	908.7	330,917.3	527,221.5	30,528.8	888,667.6
0.002	910.9	425,202.0	677,438.1	39,227.1	1,141,867.2

FDA Stream Name	RRN	Vertical Datum:	NAVD88		
FDA Reach	Fargo South (RRN)	Price Level:	Oct_2011		
Reach Index Location	460.28				
Exceedance	Damage by Damage Categories (\$000)				
<u>Probability</u>	<u>Stage</u>	<u>Res & Apt</u>	<u>Com&Farm</u>	<u>Pub&College</u>	<u>Total Damage</u>
0.1	901.0	8,586.1	4,976.2	911.6	14,473.8
0.05	904.0	74,718.9	43,304.5	7,932.8	125,956.2
0.02	907.1	541,056.4	313,578.6	57,443.0	912,078.0
0.01	908.9	939,836.0	544,698.6	99,780.7	1,584,315.3
0.005	910.9	1,348,884.0	781,772.0	143,208.8	2,273,864.8
0.002	913.2	1,748,195.0	1,013,198.1	185,602.7	2,946,995.7

FDA Stream Name	Sheyenne	Vertical Datum:	NAVD88		
FDA Reach	Fargo South (Sheyenne)	Price Level:	Oct_2011		
Reach Index Location	172308				
Exceedance	Damage by Damage Categories (\$000)				
<u>Probability</u>	<u>Stage</u>	<u>Res & Apt</u>	<u>Com&Farm</u>	<u>Pub&College</u>	<u>Total Damage</u>
0.1	904.6	-	-	-	-
0.05	905.1	-	-	-	-
0.02	905.2	-	-	-	-
0.01	905.2	-	-	-	-
0.005	905.3	-	-	-	-
0.002	905.3	2,974.1	11.7	-	2,985.8

FDA Stream Name	WRRN	Vertical Datum:	NAVD88		
FDA Reach	West Fargo Downtown	Price Level:	Oct_2011		
Reach Index Location	451.37				
Exceedance	Damage by Damage Categories (\$000)				
<u>Probability</u>	<u>Stage</u>	<u>Res & Apt</u>	<u>Com&Farm</u>	<u>Pub&College</u>	<u>Total Damage</u>
0.1	896.8	-	-	-	-
0.05	899.5	-	-	-	-
0.02	902.4	85,406.8	52,350.4	657.3	138,414.6
0.01	904.1	416,462.7	255,272.0	3,205.4	674,940.1
0.005	906.0	594,204.4	364,219.3	4,573.4	962,997.1
0.002	908.0	752,526.1	461,263.5	5,791.9	1,219,581.5

FDA Stream Name	Wsheyenne	Vertical Datum:	NAVD88		
FDA Reach	West Fargo South	Price Level:	Oct_2011		
Reach Index Location	172308				
Exceedance	Damage by Damage Categories (\$000)				
<u>Probability</u>	<u>Stage</u>	<u>Res & Apt</u>	<u>Com&Farm</u>	<u>Pub&College</u>	<u>Total Damage</u>
0.1	904.6	-	-	-	-
0.05	905.1	-	-	-	-
0.02	905.2	-	-	-	-
0.01	905.2	-	-	-	-
0.005	905.3	-	-	-	-
0.002	905.3	18,301.5	-	-	18,301.5

FDA Stream Name	HRRN	Vertical Datum:	NAVD88		
FDA Reach	Harwood (RRN)	Price Level:	Oct_2011		
Reach Index Location	432.84				
Exceedance	Damage by Damage Categories (\$000)				
<u>Probability</u>	<u>Stage</u>	<u>Res & Apt</u>	<u>Com&Farm</u>	<u>Pub&College</u>	<u>Total Damage</u>
0.1	889.2	1,153.7	94.9	505.0	1,753.6
0.05	891.0	2,829.3	232.7	1,238.5	4,300.5
0.02	892.8	4,998.2	411.1	2,188.0	7,597.3
0.01	893.9	6,602.3	543.1	2,890.2	10,035.6
0.005	894.9	8,141.7	669.7	3,564.1	12,375.5
0.002	896.0	9,873.6	812.2	4,322.2	15,008.0

FDA Stream Name	Hsheyenne	Vertical Datum:	NAVD88		
FDA Reach	Harwood (Sheyenne)	Price Level:	Oct_2011		
Reach Index Location	67984				
Exceedance	Damage by Damage Categories (\$000)				
<u>Probability</u>	<u>Stage</u>	<u>Res & Apt</u>	<u>Com&Farm</u>	<u>Pub&College</u>	<u>Total Damage</u>
0.1	888.5	355.1	-	0.9	356.1
0.05	889.7	940.4	-	2.5	942.9
0.02	890.8	1,685.8	-	4.5	1,690.3
0.01	891.1	1,943.8	-	5.2	1,949.0
0.005	891.3	2,181.8	-	5.8	2,187.6
0.002	891.5	2,842.2	-	7.6	2,849.8

FDA Stream Name	ARRN	Vertical Datum:	NAVD88		
FDA Reach	A North (RRN)	Price Level:	Oct_2011		
Reach Index Location	440.31				
Exceedance	Damage by Damage Categories (\$000)				
<u>Probability</u>	<u>Stage</u>	<u>Res & Apt</u>	<u>Com&Farm</u>	<u>Pub&College</u>	<u>Total Damage</u>
0.1	892.9	1,640.0	147.9	-	1,787.9
0.05	895.1	6,444.0	334.9	-	6,778.9
0.02	897.2	8,300.0	558.0	-	8,858.0
0.01	898.5	14,500.0	701.2	-	15,201.2
0.005	899.9	17,000.0	829.5	-	17,829.5
0.002	901.6	21,000.0	1,022.8	-	22,022.8

FDA Stream Name	ARRN	Vertical Datum:	NAVD88		
FDA Reach	A South (RRN)	Price Level:	Oct_2011		
Reach Index Location	465.1				
Exceedance	Damage by Damage Categories (\$000)				
<u>Probability</u>	<u>Stage</u>	<u>Res & Apt</u>	<u>Com&Farm</u>	<u>Pub&College</u>	<u>Total Damage</u>
0.1	903.7	2,768.0	138.7	43.5	2,950.2
0.05	906.9	10,999.5	551.1	172.8	11,723.4
0.02	909.8	23,357.0	1,170.2	366.9	24,894.0
0.01	911.3	33,391.9	1,673.0	524.5	35,589.4
0.005	912.8	44,864.3	2,247.7	704.7	47,816.7
0.002	914.8	59,621.3	2,987.1	936.5	63,544.8

FDA Stream Name	BRRN	Vertical Datum:	NAVD88		
FDA Reach	B North (RRN)	Price Level:	Oct_2011		
Reach Index Location	440.31				
Exceedance	Damage by Damage Categories (\$000)				
<u>Probability</u>	<u>Stage</u>	<u>Res & Apt</u>	<u>Com&Farm</u>	<u>Pub&College</u>	<u>Total Damage</u>
0.1	892.9	1,662.0	-	-	1,662.0
0.05	895.1	1,378.0	-	-	1,378.0
0.02	897.2	2,661.6	-	-	2,661.6
0.01	898.5	2,822.4	-	-	2,822.4
0.005	899.9	2,927.7	-	-	2,927.7
0.002	901.6	3,116.1	-	-	3,116.1

FDA Stream Name	BRRN	Vertical Datum:	NAVD88		
FDA Reach	B South (RRN)	Price Level:	Oct_2011		
Reach Index Location	465.1				
Exceedance	Damage by Damage Categories (\$000)				
<u>Probability</u>	<u>Stage</u>	<u>Res & Apt</u>	<u>Com&Farm</u>	<u>Pub&College</u>	<u>Total Damage</u>
0.1	903.7	810.9	23.7	-	834.6
0.05	906.9	3,548.4	103.5	-	3,651.9
0.02	909.8	7,607.2	221.9	-	7,829.1
0.01	911.3	10,873.6	317.2	-	11,190.8
0.005	912.8	14,607.8	426.1	-	15,033.9
0.002	914.8	19,553.8	570.4	-	20,124.2

FDA Stream Name	Asheyenne	Vertical Datum:	NAVD88		
FDA Reach	A Sheyenne	Price Level:	Oct_2011		
Reach Index Location	172308				
Exceedance	Damage by Damage Categories (\$000)				
<u>Probability</u>	<u>Stage</u>	<u>Res & Apt</u>	<u>Com&Farm</u>	<u>Pub&College</u>	<u>Total Damage</u>
0.1	904.6	-	-	-	6,045.6
0.05	905.1	-	-	-	11,016.8
0.02	905.2	-	-	-	13,811.4
0.01	905.2	-	-	-	14,418.3
0.005	905.3	-	-	-	15,368.1
0.002	905.3	17,181.1	50.1	16.2	17,247.5

FDA Stream Name	ShySA	Vertical Datum:	NAVD88		
FDA Reach	Sheyenne Storage A	Price Level:	Oct_2011		
Reach Index Location	166				
Exceedance	Damage by Damage Categories (\$000)				
<u>Probability</u>	<u>Stage</u>	<u>Res & Apt</u>	<u>Com&Farm</u>	<u>Pub&College</u>	<u>Total Damage</u>
0.1	889.0	118.7	0.1	-	118.8
0.05	890.2	502.5	0.4	-	502.9
0.02	891.2	2,408.9	2.1	-	2,411.0
0.01	891.8	3,918.4	3.4	-	3,921.8
0.005	892.0	4,583.7	4.0	-	4,587.6
0.002	892.3	6,493.5	5.6	-	6,499.1

FDA Stream Name	RRN	Vertical Datum:	NAVD88		
FDA Reach	Kragnes	Price Level:	Oct_2011		
Reach Index Location	434.61				
Exceedance	Damage by Damage Categories (\$000)				
<u>Probability</u>	<u>Stage</u>	<u>Res & Apt</u>	<u>Com&Farm</u>	<u>Pub&College</u>	<u>Total Damage</u>
0.1	890.0	163.5	43.5	-	207.1
0.05	891.8	795.6	211.8	-	1,007.5
0.02	893.5	1,837.7	489.3	-	2,327.0
0.01	894.5	2,442.6	650.4	-	3,092.9
0.005	895.5	2,942.0	783.3	-	3,725.4
0.002	896.7	3,665.4	976.0	-	4,641.3

FDA Stream Name	RRN	Vertical Datum:	NAVD88		
FDA Reach	Oakport	Price Level:	Oct_2011		
Reach Index Location	440.31				
Exceedance	Damage by Damage Categories (\$000)				
<u>Probability</u>	<u>Stage</u>	<u>Res & Apt</u>	<u>Com&Farm</u>	<u>Pub&College</u>	<u>Total Damage</u>
0.1	892.9	-	-	-	-
0.05	895.2	-	-	-	-
0.02	897.2	-	-	-	-
0.01	898.5	-	-	-	-
0.005	899.9	-	-	-	-
0.002	901.6	41,613.9	130.6	27.4	41,772.0

FDA Stream Name	RRN	Vertical Datum:	NAVD88		
FDA Reach	North of Moorhead	Price Level:	Oct_2011		
Reach Index Location	442.93				
Probability	Stage	Res & Apt	Com&Farm	Pub&College	Total Damage
<u>0.1</u>	<u>893.572</u>	<u>993.354</u>	<u>21.8769</u>	<u>0.108279</u>	<u>1015.34</u>
0.05	895.8	3,539.1	77.9	0.4	3,617.4
0.02	897.8	8,707.8	191.8	0.9	8,900.5
0.01	899.1	13,220.4	291.2	1.4	13,513.0
0.005	900.4	18,364.6	404.5	2.0	18,771.1
0.002	902.0	26,137.4	575.6	2.8	26,715.9

FDA Stream Name	RRN	Vertical Datum:	NAVD88		
FDA Reach	Moorhead North	Price Level:	Oct_2011		
Reach Index Location	449.61				
Exceedance	Damage by Damage Categories (\$000)				
<u>Probability</u>	<u>Stage</u>	<u>Res & Apt</u>	<u>Com&Farm</u>	<u>Pub&College</u>	<u>Total Damage</u>
0.1	895.9	39.3	18.2	3.6	61.1
0.05	898.5	2,392.7	1,111.2	218.6	3,722.5
0.02	901.2	17,629.9	8,187.8	1,610.5	27,428.1
0.01	902.7	35,638.8	16,551.6	3,255.5	55,445.9
0.005	904.3	67,576.0	31,384.2	6,172.9	105,133.0
0.002	906.3	134,708.2	62,562.3	12,305.3	209,576.0

FDA Stream Name	RRN	Vertical Datum:	NAVD88		
FDA Reach	Moorhead Central	Price Level:	Oct_2011		
Reach Index Location	452.7				
Exceedance	Damage by Damage Categories (\$000)				
<u>Probability</u>	<u>Stage</u>	<u>Res & Apt</u>	<u>Com&Farm</u>	<u>Pub&College</u>	<u>Total Damage</u>
0.1	897.8	60.6	6.0	4.2	70.7
0.05	900.8	4,558.4	448.5	314.3	5,321.1
0.02	904.0	43,297.8	4,259.8	2,984.9	50,542.5
0.01	905.9	112,313.5	11,049.8	7,742.8	131,106.0
0.005	908.0	232,492.5	22,873.5	16,027.9	271,394.0
0.002	910.3	398,668.0	39,222.4	27,484.0	465,374.0

FDA Stream Name	RRN	Vertical Datum:	NAVD88		
FDA Reach	Moorhead South	Price Level:	Oct_2011		
Reach Index Location	460.28				
Exceedance	Damage by Damage Categories (\$000)				
<u>Probability</u>	<u>Stage</u>	<u>Res & Apt</u>	<u>Com&Farm</u>	<u>Pub&College</u>	<u>Total Damage</u>
0.1	901.0	1,384.4	133.5	32.3	1,550.3
0.05	904.0	15,958.4	1,539.5	372.6	17,870.5
0.02	907.1	61,845.0	5,966.1	1,444.1	69,255.2
0.01	908.9	107,314.6	10,352.5	2,505.8	120,173.0
0.005	910.9	179,600.7	17,325.8	4,193.7	201,120.0
0.002	913.2	281,209.3	27,127.8	6,566.3	314,903.0

FDA Stream Name	BRRN	Vertical Datum:	NAVD88		
FDA Reach	South of Moorhead	Price Level:	Oct_2011		
Reach Index Location	468.9				
Exceedance	Damage by Damage Categories (\$000)				
<u>Probability</u>	<u>Stage</u>	<u>Res & Apt</u>	<u>Com&Farm</u>	<u>Pub&College</u>	<u>Total Damage</u>
0.1	905.5	46.9	8.9	0.5	56.3
0.05	908.5	332.3	63.2	3.4	398.9
0.02	911.1	911.5	173.2	9.2	1,093.9
0.01	912.3	1,423.8	270.6	14.4	1,708.8
0.005	913.7	1,978.9	376.1	20.0	2,375.0
0.002	915.6	2,718.6	516.7	27.5	3,262.8

FDA Stream Name	CRRN	Vertical Datum:	NAVD88			
FDA Reach	South of Thompson	Price Level:	Oct_2011			
Reach Index Location	324.41					
Exceedance	Damage by Damage Categories (1,000's)					
<u>Probability</u>	<u>Stage</u>	<u>Res & Apt</u>	<u>Commercial</u>	<u>Pub&College</u>	<u>Farm</u>	<u>Total</u>
0.1	841.6	0.0	-	-	0.0	0.0
0.05	845.6	2.7	-	-	3.4	6.1
0.02	850.1	54.0	-	-	66.9	120.9
0.01	853.0	191.2	-	-	236.8	428.1
0.005	855.6	517.3	-	-	640.5	1,157.8
0.002	858.6	1,560.6	-	-	1,932.5	3,493.1

FDA Stream Name	CRRN	Vertical Datum:	NAVD88			
FDA Reach	Climax MN&ND	Price Level:	Oct_2011			
Reach Index Location	335.01					
Exceedance	Damage by Damage Categories (1,000's)					
<u>Probability</u>	<u>Stage</u>	<u>Res & Apt</u>	<u>Commercial</u>	<u>Pub&College</u>	<u>Farm</u>	<u>Total</u>
0.1	845.8	7.5	0.3	0.1	7.3	15.2
0.05	850.1	18.0	0.8	0.2	17.5	36.5
0.02	855.0	147.3	6.8	1.5	143.9	299.5
0.01	858.2	343.1	15.9	3.5	335.1	697.6
0.005	861.2	834.2	38.7	8.6	814.7	1,696.2
0.002	864.6	2,619.1	121.4	27.1	2,557.6	5,325.2

FDA Stream Name	CRRN	Vertical Datum:	NAVD88			
FDA Reach	Shelly MN&ND	Price Level:	Oct_2011			
Reach Index Location	359.73					
Exceedance	Damage by Damage Categories (1,000's)					
<u>Probability</u>	<u>Stage</u>	<u>Res & Apt</u>	<u>Commercial</u>	<u>Pub&College</u>	<u>Farm</u>	<u>Total</u>
0.1	856.5	3.9	-	0.0	7.8	11.8
0.05	860.1	42.5	-	0.0	84.6	127.0
0.02	863.9	449.0	-	0.1	894.2	1,343.2
0.01	866.4	1,119.4	-	0.2	2,229.4	3,349.0
0.005	868.5	1,902.7	-	0.4	3,789.4	5,692.5
0.002	871.0	3,118.5	-	0.6	6,210.7	9,329.8

FDA Stream Name	CRRN	Vertical Datum:	NAVD88			
FDA Reach	Perley-Hendrum MN&ND	Price Level:	Oct_2011			
Reach Index Location	381.71					
Exceedance	Damage by Damage Categories (1,000's)					
<u>Probability</u>	<u>Stage</u>	<u>Res & Apt</u>	<u>Commercial</u>	<u>Pub&College</u>	<u>Farm</u>	<u>Total</u>
0.1	866.6	29.1	-	-	53.2	82.3
0.05	868.7	230.2	-	-	421.1	651.4
0.02	870.8	994.5	-	-	1,819.1	2,813.6
0.01	872.0	1,623.4	-	-	2,969.2	4,592.6
0.005	873.2	2,071.9	-	-	3,789.6	5,861.5
0.002	874.5	2,669.9	-	-	4,883.4	7,553.3

FDA Stream Name	CRRN	Vertical Datum:	NAVD88			
FDA Reach	Halstad MN&ND	Price Level:	Oct_2011			
Reach Index Location	397.8					
Exceedance	Damage by Damage Categories (1,000's)					
<u>Probability</u>	<u>Stage</u>	<u>Res & Apt</u>	<u>Commercial</u>	<u>Pub&College</u>	<u>Farm</u>	<u>Total</u>
0.1	872.7	49.2	0.2	-	93.3	142.7
0.05	874.6	244.5	1.0	-	463.7	709.2
0.02	876.4	876.3	3.5	-	1,662.1	2,541.9
0.01	877.4	1,615.3	6.4	-	3,063.9	4,685.7
0.005	878.1	2,363.6	9.4	-	4,483.4	6,856.4
0.002	878.9	3,024.7	12.1	-	5,737.3	8,774.0

FDA Stream Name	CRRN	Vertical Datum:	NAVD88			
FDA Reach	Georgetown MN&ND	Price Level:	Oct_2011			
Reach Index Location	414.98					
Exceedance	Damage by Damage Categories (1,000's)					
<u>Probability</u>	<u>Stage</u>	<u>Res & Apt</u>	<u>Commercial</u>	<u>Pub&College</u>	<u>Farm</u>	<u>Total</u>
0.1	879.9	184.8	1.3	1.4	142.3	329.8
0.05	881.2	637.4	4.5	4.7	490.8	1,137.4
0.02	882.4	1,565.4	11.2	11.4	1,205.5	2,793.5
0.01	883.2	2,302.0	16.4	16.8	1,772.8	4,108.0
0.005	883.8	3,036.8	21.7	22.2	2,338.7	5,419.3
0.002	884.4	3,796.1	27.1	27.7	2,923.4	6,774.3

FDA Stream Name	BRRN	Vertical Datum:	NAVD88			
FDA Reach	Intermediate MN&ND	Price Level:	Oct_2011			
Reach Index Location	423.96					
Exceedance	Damage by Damage Categories (1,000's)					
<u>Probability</u>	<u>Stage</u>	<u>Res & Apt</u>	<u>Commercial</u>	<u>Pub&College</u>	<u>Farm</u>	<u>Total</u>
0.1	883.2	28.6	-	-	50.1	78.7
0.05	884.5	102.7	-	-	180.4	283.1
0.02	885.6	294.7	-	-	517.5	812.1
0.01	886.3	472.3	-	-	829.4	1,301.7
0.005	886.8	660.9	-	-	1,160.5	1,821.4
0.002	887.5	893.7	-	-	1,569.4	2,463.0

FDA Stream Name	RRN	Vertical Datum:	NAVD88			
FDA Reach	Upstream (RRN)	Price Level:	Oct_2011			
Reach Index Location	500.01					
Exceedance	Damage by Damage Categories					
<u>Probability</u>	<u>Stage</u>	<u>Res & Apt</u>	<u>Commercial</u>	<u>Pub&College</u>	<u>Farm</u>	<u>Total</u>
0.1	916.3	7.8	0.1	0.1	0.7	8.8
0.05	919.4	150.3	2.2	2.7	13.7	168.9
0.02	922.8	3,677.8	53.5	65.9	334.2	4,131.5
0.01	924.9	10,887.9	158.5	195.0	989.4	12,230.8
0.005	927.0	19,784.0	288.0	354.3	1,797.9	22,224.2
0.002	929.7	40,971.8	596.4	733.8	3,723.3	46,025.3

FDA Stream Name	Wild Rice ND	Vertical Datum:	NAVD88			
FDA Reach	Upstream Wild Rice	Price Level:	Oct_2011			
Reach Index Location	32.12					
Exceedance	Damage by Damage Categories					
<u>Probability</u>	<u>Stage</u>	<u>Res & Apt</u>	<u>Commercial</u>	<u>Pub&College</u>	<u>Farm</u>	<u>Total</u>
0.1	923.1	62.1	-	0.4	33.2	95.7
0.05	926.5	611.0	-	3.6	326.8	941.3
0.02	929.7	2,199.7	-	13.0	1,176.4	3,389.1
0.01	931.6	4,569.9	-	26.9	2,444.0	7,040.8
0.005	933.1	7,393.9	-	43.5	3,954.3	11,391.8
0.002	934.6	11,056.0	-	65.1	5,912.8	17,033.9

All Reaches			Price Level:		Oct_2011
Exceedance Probability	Damage by Damage Categories (\$000)				
	Stage	Res & Apt	Com&Farm	Pub&College	Total Damage
0.1	Varies by Reach	30,157.3	19,880.3	3,675.5	53,713.0
0.05	Varies by Reach	205,787.4	132,735.4	22,558.8	361,081.5
0.02	Varies by Reach	1,361,316.4	1,281,011.5	178,398.1	2,820,726.0
0.01	Varies by Reach	2,741,286.4	2,663,937.5	338,255.7	5,743,479.6
0.005	Varies by Reach	3,983,076.3	3,788,412.0	483,664.5	8,255,152.8
0.002	Varies by Reach	5,380,389.1	4,809,520.1	621,690.0	10,811,599.2

All Downstream Reaches				Price Level:	Oct_2011
Exceedance Probability	Damage by Damage Categories (\$000)				
	Stage	Res & Apt	Com&Farm	Pub&College	Total Damage
0.1	Varies by Reach	303.1	356.0	1.4	660.5
0.05	Varies by Reach	1,277.9	1,667.9	4.9	2,950.7
0.02	Varies by Reach	4,381.1	6,330.6	13.0	10,724.8
0.01	Varies by Reach	7,666.7	11,475.4	20.6	19,162.6
0.005	Varies by Reach	11,387.4	17,086.6	31.2	28,505.2
0.002	Varies by Reach	17,682.5	25,974.9	55.4	43,712.7

All Metro Reaches			Price Level:	Oct_2011	
Exceedance Probability	Damage by Damage Categories (\$000)				
	Stage	Res & Apt	Com&Farm	Pub&College	Total Damage
0.1	Varies by Reach	29,784.3	19,490.2	3,673.5	52,948.1
0.05	Varies by Reach	203,748.1	130,724.9	22,547.6	357,020.6
0.02	Varies by Reach	1,351,057.7	1,273,116.7	178,306.3	2,802,480.7
0.01	Varies by Reach	2,718,162.0	2,648,870.2	338,013.2	5,705,045.3
0.005	Varies by Reach	3,944,511.0	3,765,285.2	483,235.5	8,193,031.7
0.002	Varies by Reach	5,310,678.8	4,773,312.7	620,835.7	10,704,827.3

All Upstream Reaches				Price Level:	Oct_2011
Exceedance Probability	Damage by Damage Categories (\$000)				
	Stage	Res & Apt	Com&Farm	Pub&College	Total Damage
0.1	Varies by Reach	69.9	34.0	0.5	104.4
0.05	Varies by Reach	761.3	342.6	6.3	1,110.2
0.02	Varies by Reach	5,877.5	1,564.2	78.8	7,520.5
0.01	Varies by Reach	15,457.7	3,591.9	221.9	19,271.6
0.005	Varies by Reach	27,177.9	6,040.2	397.8	33,616.0
0.002	Varies by Reach	52,027.8	10,232.6	798.8	63,059.2

EXHIBIT H

Phase IV EAD by Reach by Category for Existing Conditions (2011)

Expected Annual Damage by Damage Categories and Damage Reaches

(Expected Annual Damages in \$1,000's - Price Level Oct 2011)

	<u>Residential</u>	<u>Commercial</u>	<u>Public</u>	<u>Total</u>
<u>Fargo North</u>				
Fargo North End	8,169.0	4,376.5	370.7	12,916.1
Ridgewood	2,325.0	6,249.7	1,127.4	9,702.1
Near North	5,954.2	11,452.5	2,485.7	19,892.4
Downtown North	473.5	7,295.6	1,149.7	8,918.8
Downtown South	5,202.9	7,125.5	485.2	12,813.6
Near South	2,510.3	5,144.9	289.1	7,944.3
Lindenwood Area	6,627.0	10,558.3	611.4	17,796.7
Subtotal	31,261.9	52,202.8	6,519.1	89,984.0
<u>Fargo South</u>				
Fargo South (RRN)	30,586.2	17,726.7	3,247.3	51,560.0
Fargo South(Sheyenne)	73.2	0.3	-	73.5
Subtotal	30,659.4	17,727.0	3,247.3	51,633.5
<u>West Fargo</u>				
WF Downtown (RRN)	8,934.4	5,476.4	68.8	14,479.5
WF South (Sheyenne)	880.8	-	-	880.8
Subtotal	9,815.2	5,476.4	68.8	15,360.3
<u>Harwood</u>				
Harwood Red	388.2	31.9	170.0	590.1
Harwood Shy	127.7	-	0.3	128.1
Subtotal	515.9	31.9	170.3	718.2
<u>Cass County</u>				
A North (RRN)	1,621.4	46.4	-	1,667.8
A South (RRN)	1,846.8	92.5	29.0	1,968.4
B North (RRN)	404.2	-	-	404.2
B South (RRN)	571.9	16.7	-	588.6
Subtotal	4,444.4	155.6	29.0	4,629.0
A Sheyenne	2,419.9	7.1	2.3	2,429.3
Sheyenne Storage A	131.4	0.1	-	131.6
Subtotal	2,551.3	7.2	2.3	2,560.8

(Expected Annual Damages in \$1,000's - Price Level Oct 2011)

<u>Moorhead/Clay County</u>	<u>Residential</u>	<u>Commercial</u>	<u>Public</u>	<u>Total</u>
Kragnes	118.4	31.5	-	149.9
Oakport	163.9	0.5	0.1	164.6
North of Moorhead	619.1	13.6	0.1	632.8
Moorhead North	1,433.7	665.9	131.0	2,230.6
Moorhead Central	4,147.1	408.0	285.9	4,841.1
Moorhead South	4,258.4	410.8	99.4	4,768.6
South of Moorhead	58.6	11.1	0.6	70.4
Subtotal	10,799.3	1,541.5	517.1	12,857.9
Grand Total	90,047.4	77,142.4	10,553.8	177,743.6

(Expected Annual Damages in \$1,000's - Price Level Oct 2011)

<u>Downstream - CRRN</u>	<u>Residential</u>	<u>Commercial</u>	<u>Public</u>	<u>Farm</u>	<u>Total</u>
XS-324.41	11.7	-	-	14.5	26.2
XS-335.01	23.7	1.1	0.2	23.2	48.2
XS-359.73	36.8	-	0.0	73.3	110.2
XS-381.71	56.3	-	-	102.9	159.1
XS-397.8	57.7	0.2	-	109.4	167.3
XS-414.98	108.3	0.8	0.8	83.4	193.2
Subtotal	294.4	2.1	1.0	406.7	704.3
					-
<u>Downstream - BRRN</u>					
XS-423.96	21.4	-	-	37.5	58.9
Total Downstream	315.8	2.1	1.0	444.2	763.2

(Expected Annual Damages in \$1,000's - Price Level Oct 2011)

<u>Upstream</u>	<u>Residential</u>	<u>Commercial</u>	<u>Public</u>	<u>Farm</u>	<u>Total</u>
RRN	389.2	5.7	7.0	35.4	437.2
Wild Rice	165.8	-	1.0	88.7	255.4
Total Upstream	554.99	5.67	7.95	124.02	692.63

EXHIBIT I
Phase IV Reach & Levee Configuration

Metro Area Reaches, Beginning Damage, and Levees

Fargo Moorhead Metro Feasibility Study

Reach	Stream	Bank	WSP Index RM	Dnstrm	Upstrm	TOL	Target Stage	Beginning Damage Stage	Beginning Damage Frequency
Fargo North End	RRN	Left	442.93	437	447.3	---	892.39	886.74	0.2
Ridgewood	RRN	Left	447.78	447.3	448.2	898	898	888.13	0.2
Near North	RRN	Left	449.61	448.2	450.9	---	895.1	889.14	0.2
Downtown North	RRN	Left	451.37	450.9	451.7	---	894.25	894.02	0.1
Downtown South	RRN	Left	452.25	451.7	452.6	902.2	902.2	882.38	0.5
Near South	RRN	Left	452.7	452.6	453	904*	904	895.14	0.1
Lindenwood Area	RRN	Left	454.1	453	455.3	---	900.64	898.44	0.05
Z_Other**	RRN	Both	650	600	700				
<u>Fargo South</u>									
From RRN	RRN	Left	460.28	455.3	464	---	901.48	898.52	0.1
From Sheyenne	Sheyenne	Both	172308	160670	186000	---	904.72	905.59	0.002
<u>West Fargo</u>									
WF Downtown	WRRN	Left	451.37	447.42	455.23	---	900.03	902.94	0.005
WF South	Wsheyenne	Both	172308	160670	186000	---	904.81	905.59	0.002
<u>Harwood</u>									
Harwood Red	HRRN	Left	432.84	430.23	433.83				
Harwood Sheyenne	Hsheyenne	Both	67984	94542	72114				
<u>Cass County</u>									
ANorth (RRN)	ARRN	Left	440.31	422.69	449.09	---	892.99	895.36	0.01
ASouth (RRN)	ARRN	Left	465.1	460	482	---	896.77	898.15	0.2
BNorth (RRN)	BRRN	Left	440.31	422.69	449.09	---	889.33	890.11	0.1
BSouth (RRN)	BRRN	Left	465.1	460	482	---	905.06	898.15	0.2

Metro Area Reaches, Beginning Damage, and Levees

Fargo Moorhead Metro Feasibility Study

Reach	Stream	Bank	WSP Index RM	Dnstrm	Upstrm	TOL	Target Stage	Beginning Damage Stage	Beginning Damage Frequency
ASheyenne	Asheyenne	Both	172308	55000	232850	---	904.16	905.16	0.05
ShySA		Both	166	140	179	---	892.5	890.38	0.02
<u>Moorhead</u>									
Kragnes	RRN	Right	434.61	428	437	---	888.34	887.73	0.1
Oakport	RRN	Right	440.31	437	442.14	900.5	900.5	897.07	0.02
North of Moorhead	RRN	Right	442.93	442.14	447	---	892.26	892.88	0.05
Moorhead North	RRN	Right	449.61	447	451.7	---	896.61	889.14	0.2
Moorhead Central	RRN	Right	452.7	451.7	455.28	---	900.07	891.15	0.2
Moorhead South	RRN	Right	460.28	455.28	468.3	---	900.29	897.14	0.1
South of Moorhead	BRRN	Right	468.9	468.3	478.9	---	905.27	906.98	0.05

*Geotechnical failure analysis

Stage	890	895	897.4	900	903.95
Probability of failure	0	0.01	0.01	0.21	0.26

**This is a dummy reach for calculating Emergency, Transportation, and Sewer&Infrastructure Damages

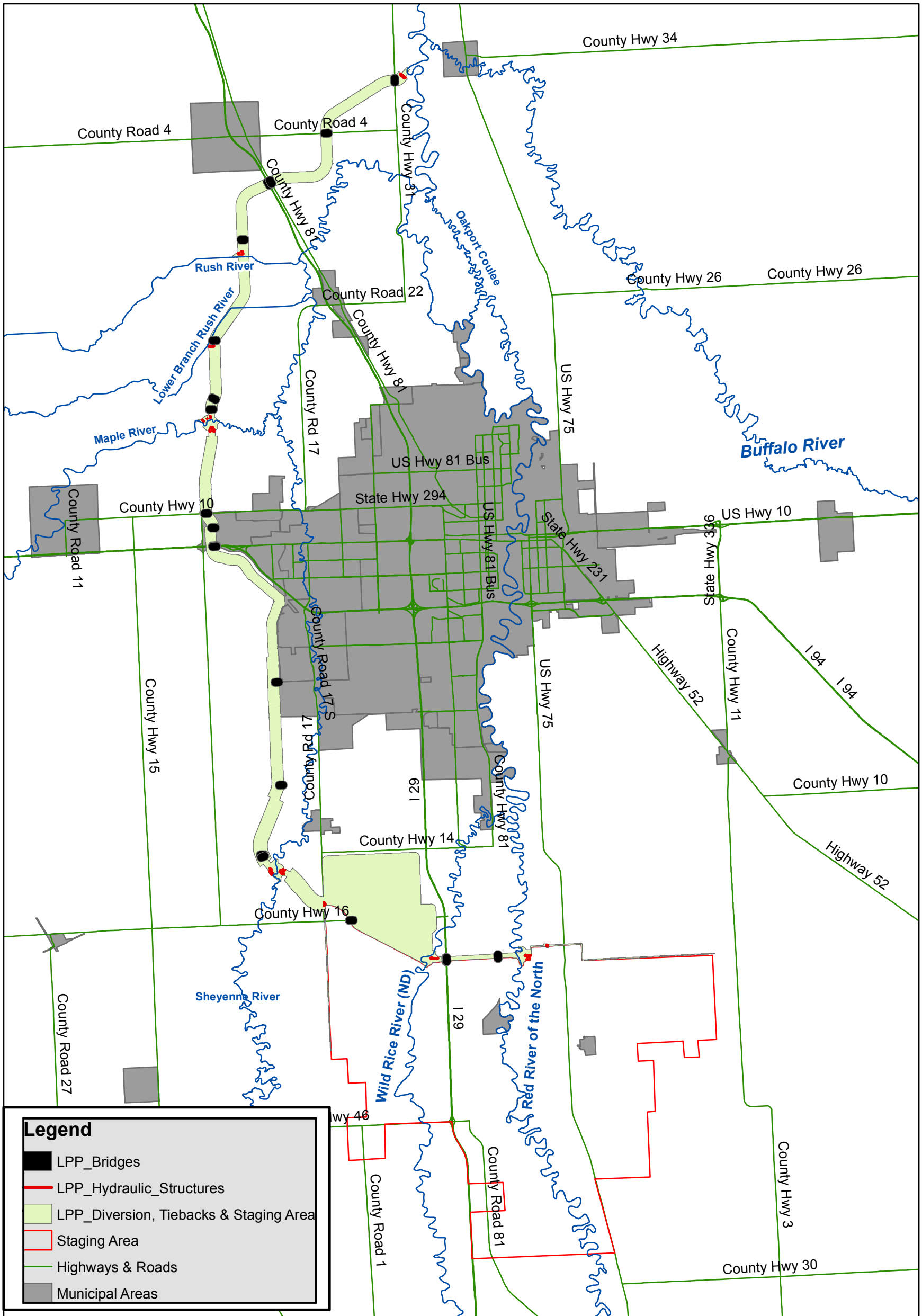
Frequency and Ratings curves from XS 452.7 are used in this reach

Downstream and Upstream Reaches, Beginning Damage, and Levees

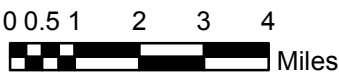
Fargo Moorhead Metro Feasibility Study

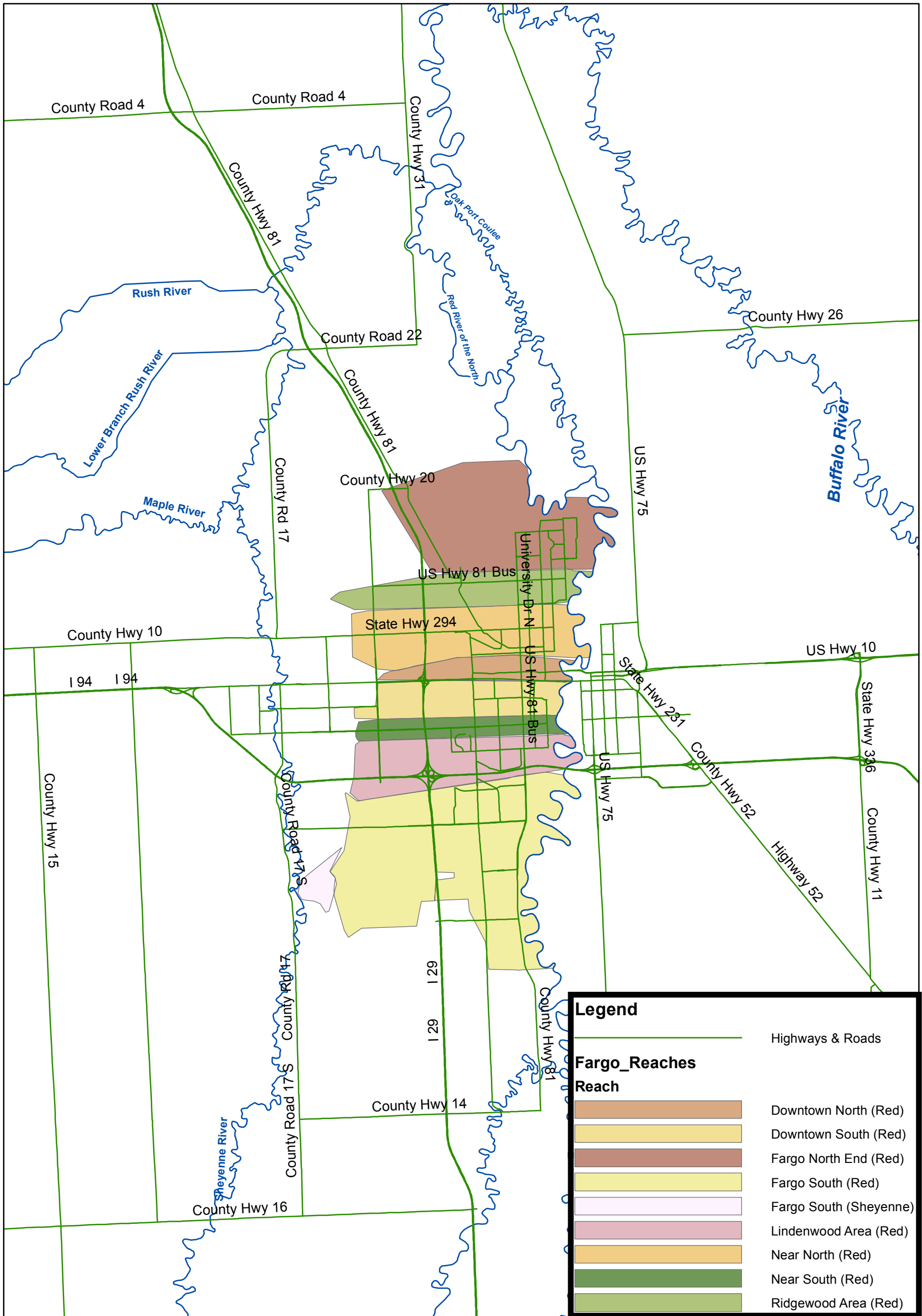
Reach	Stream	Bank	WSP Index RM	Dnstrm	Upstrm
Downstream					
South of Thompson - XS 324.41	CRRN	Both	324.41	316.26	328.19
Climax MN&ND - XS 335.01	CRRN	Both	335.01	328.19	349.71
Shelly MN&ND - XS 359.73	CRRN	Both	359.73	349.71	370.03
Perley-Hendrum MN&ND - XS 381.71	CRRN	Both	381.71	370.03	385.04
Halstad MN&ND - XS 397.8	CRRN	Both	397.80	385.04	406.51
Georgetown MN&ND - XS 414.98	CRRN	Both	414.98	406.51	431.95
Intermediate - XS 423.96	BRRN	Both	423.96	419.92	432.55
Upstream_Red	RRN	Both	500.01	478	525
Upstream_WR	Wild Rice ND	Both	32.12	11	43

EXHIBIT J
Maps of Reaches & Alternatives



Locally Preferred Plan (LPP)





Legend

Highways & Roads

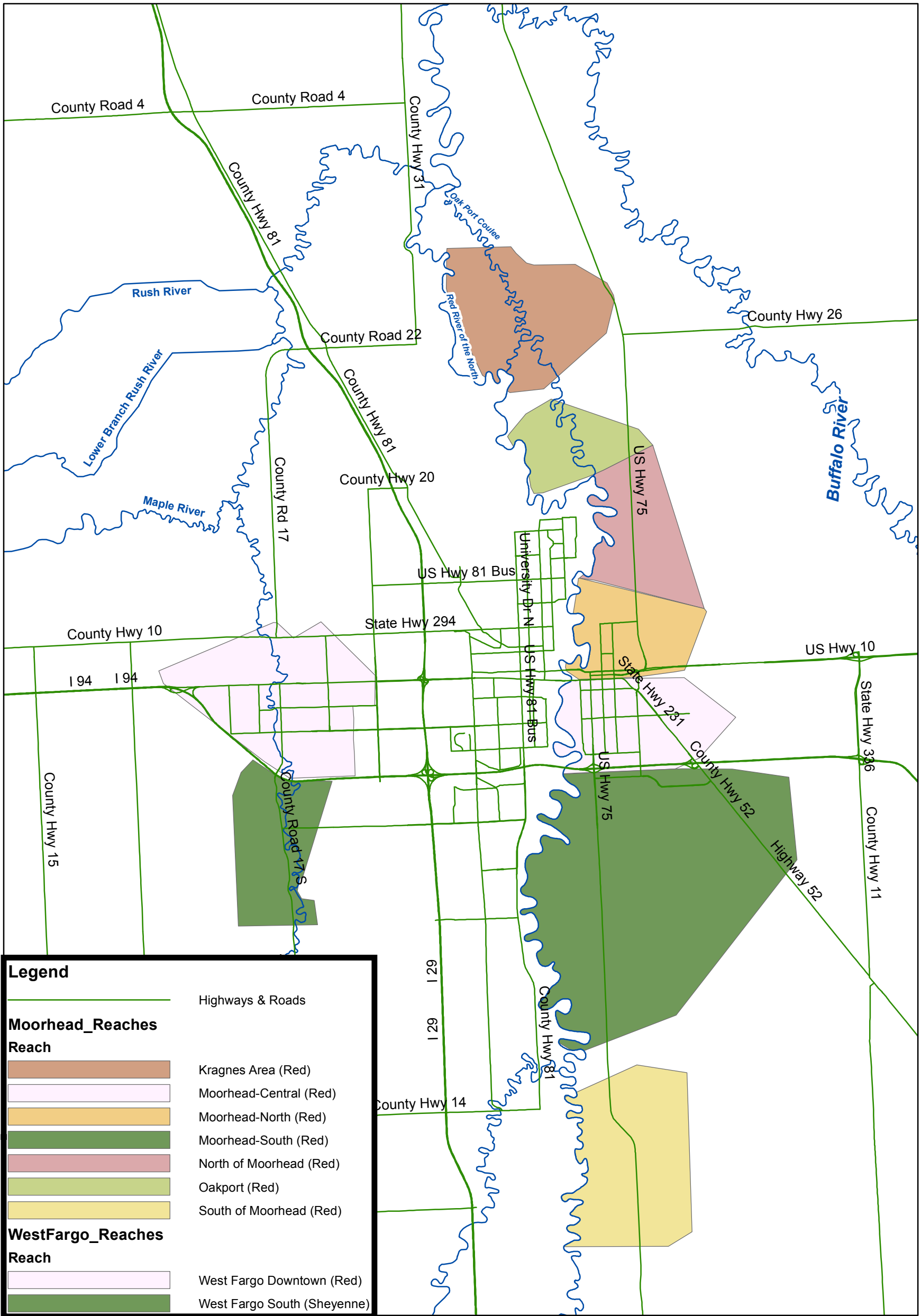
Fargo_Reaches

Reach

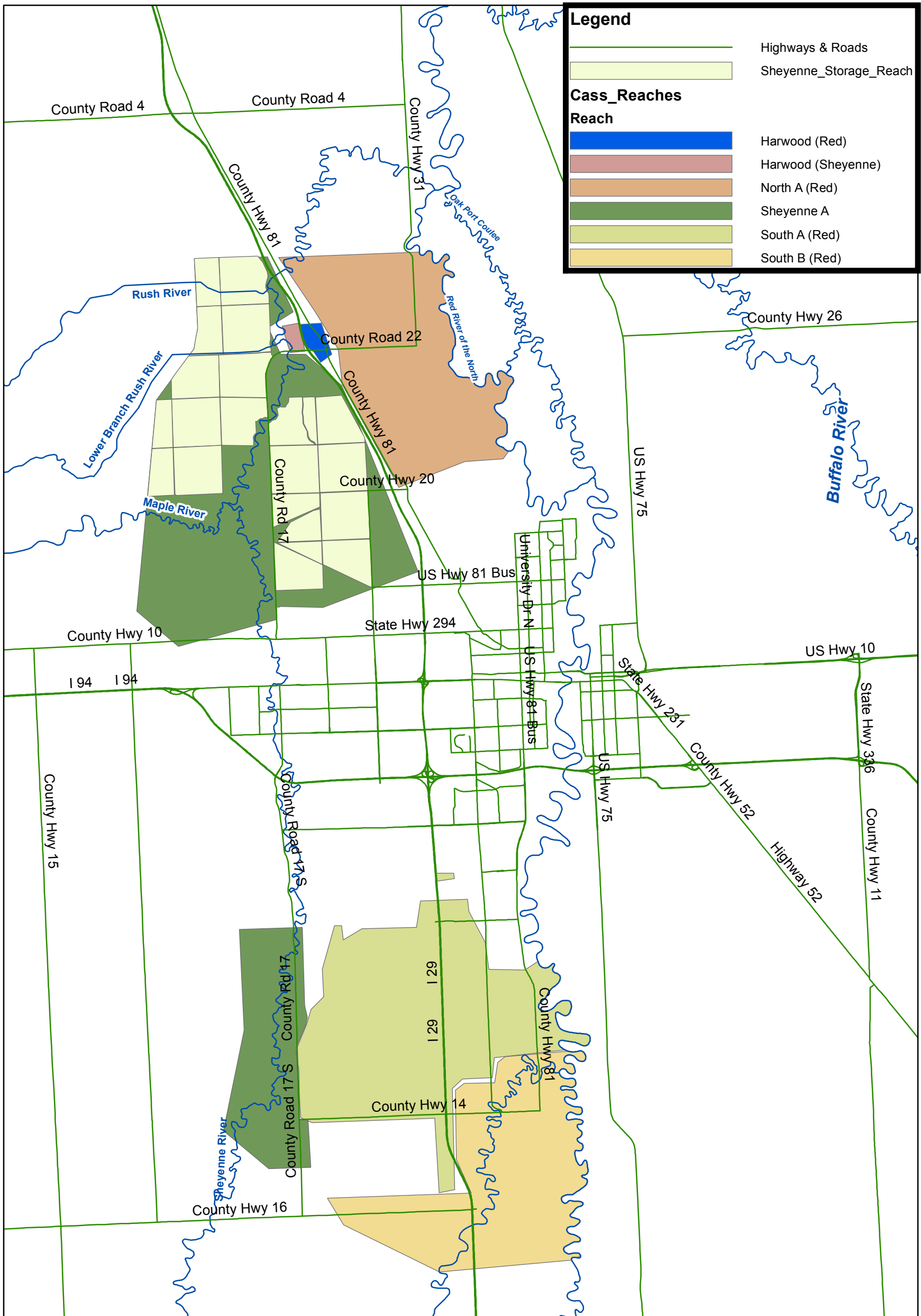
- Downtown North (Red)
- Downtown South (Red)
- Fargo North End (Red)
- Fargo South (Red)
- Fargo South (Sheyenne)
- Lindenwood Area (Red)
- Near North (Red)
- Near South (Red)
- Ridgewood Area (Red)

Fargo Reaches



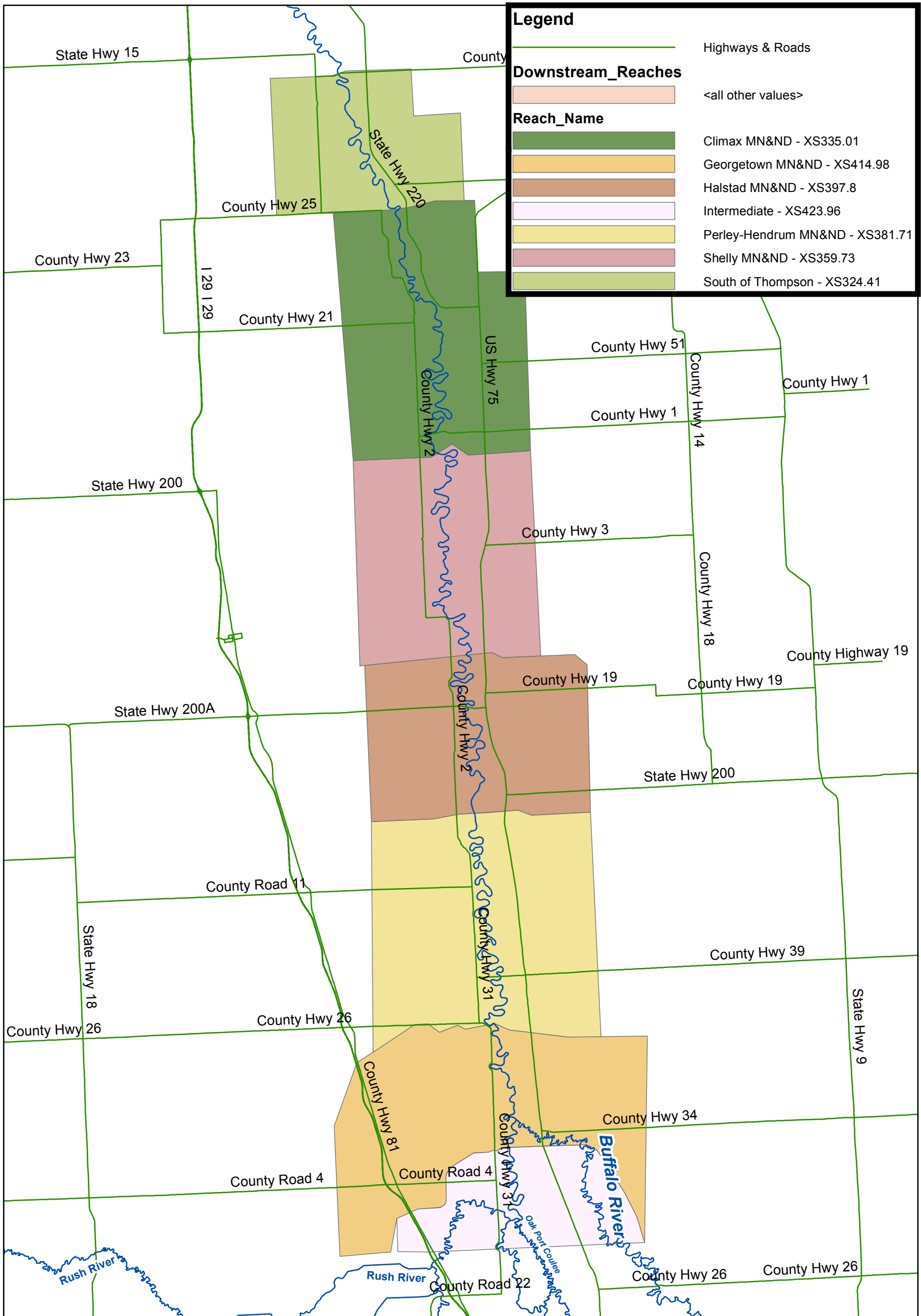


West Fargo & Moorhead Reaches

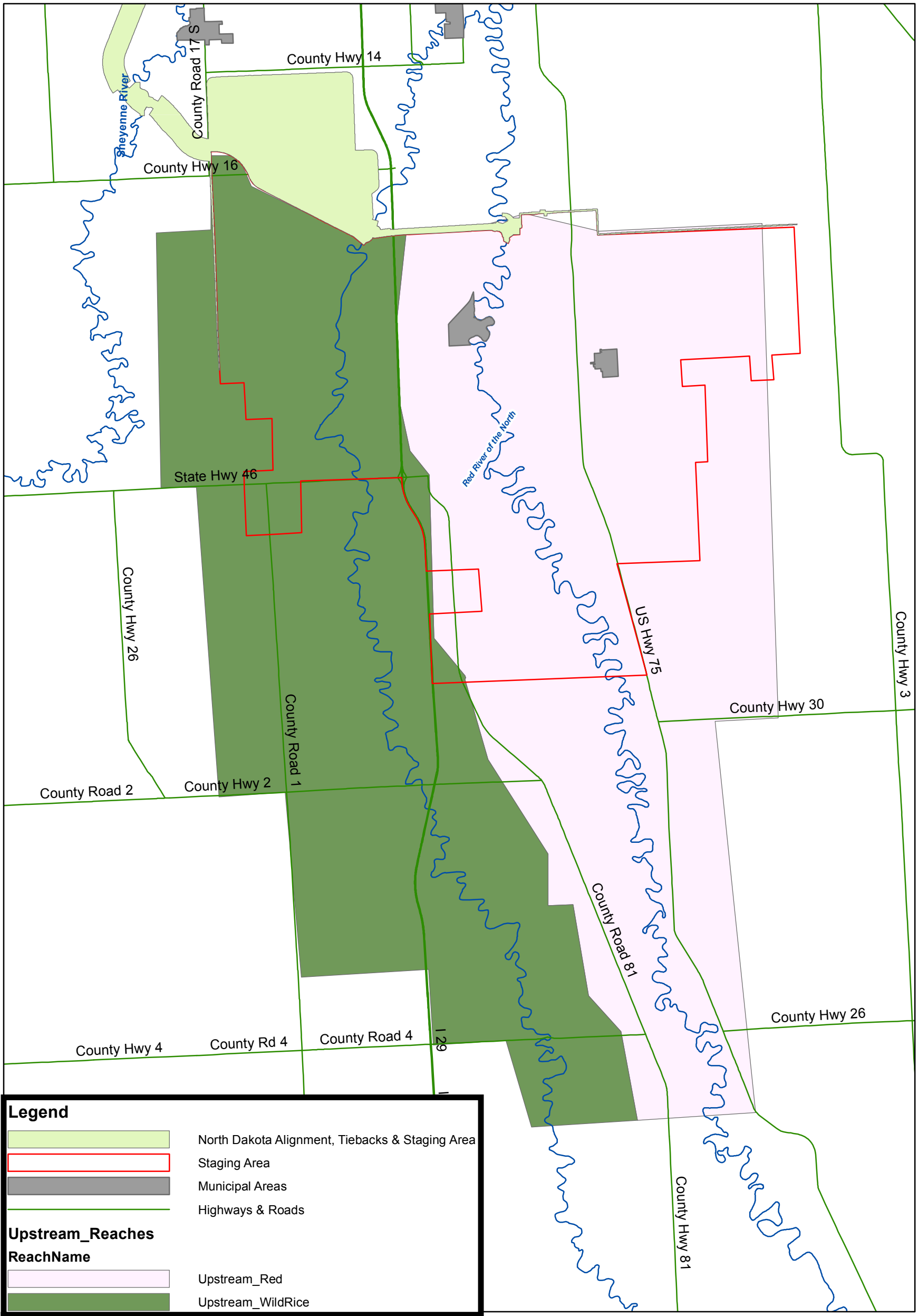


Cass County Reaches



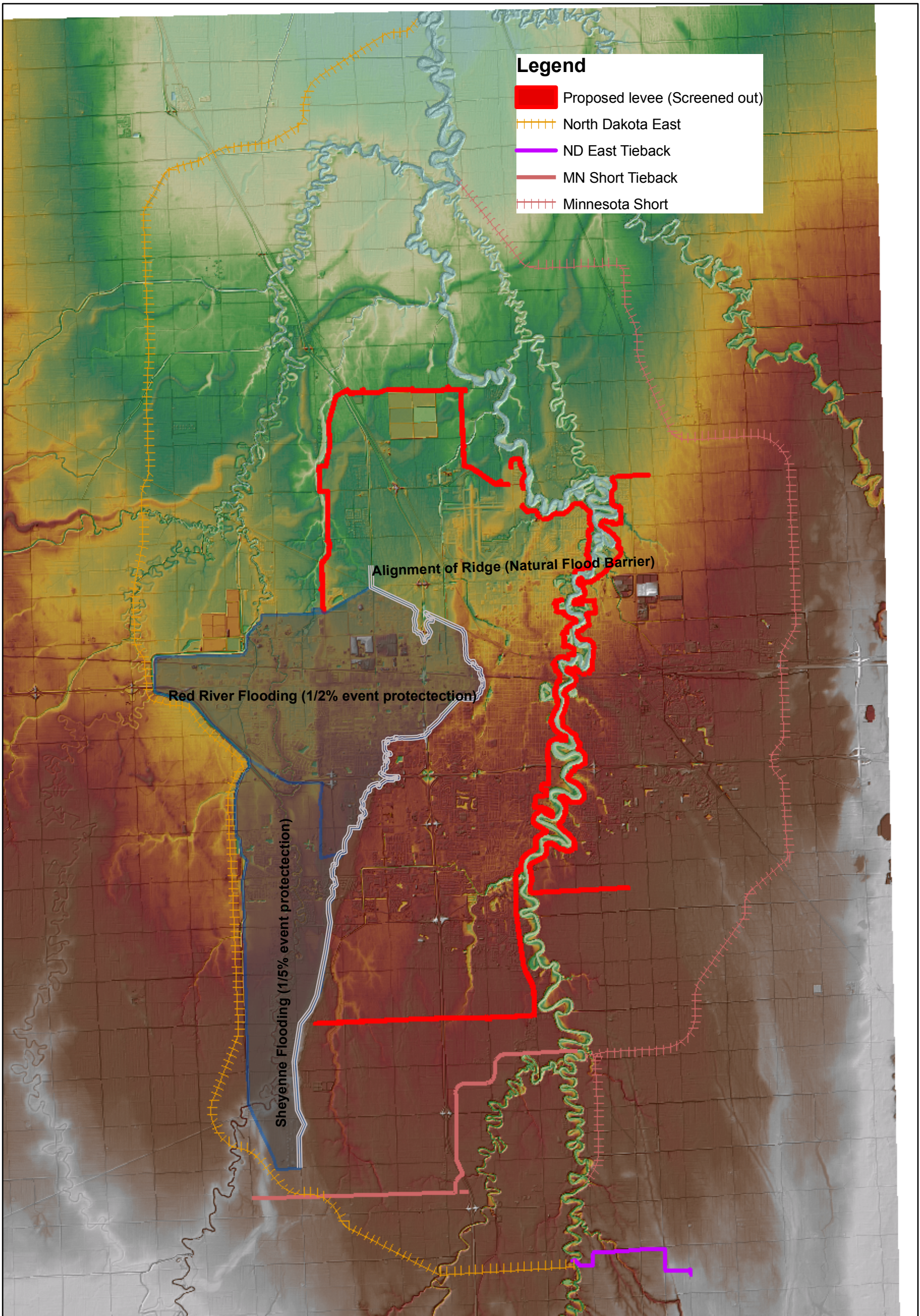


Downstream Reaches



Upstream Reaches





Shaded Relief & Geographic Features

EXHIBIT K
Interest during Construction

Phase IV Interest During Construction

Fargo-Moorhead Metro Feasibility Study

Scheduled Construction Cost						
	ND35K	ND w/Staging	MN35K	Rec ND35k	Rec NDwStaging	Rec MN
May-2012	\$87,348	\$102,647	\$80,345			
Dec-2012	\$174,696	\$205,293	\$160,689			
Dec-2013	\$174,696	\$205,293	\$160,689			
Dec-2014	\$174,696	\$205,293	\$160,689			
Dec-2015	\$174,696	\$205,293	\$160,689			
Dec-2016	\$174,696	\$205,293	\$160,689			
Dec-2017	\$174,696	\$205,293	\$160,689			\$15,747
Dec-2018	\$174,696	\$205,293	\$160,689	\$19,418	\$18,158	\$15,747
Dec-2019	\$174,696	\$205,293		\$19,418	\$18,158	
Nominal Total	\$1,484,913	\$1,744,991	\$1,205,169	\$38,835	\$36,315	\$31,494
Compounding						
Years to base						
8	\$33,348	\$39,189	\$30,674	\$0	\$0	\$0
7	\$57,133	\$67,140	\$52,552	\$0	\$0	\$0
6	\$47,949	\$56,347	\$44,105	\$0	\$0	\$0
5	\$39,129	\$45,982	\$35,992	\$0	\$0	\$0
4	\$30,658	\$36,028	\$28,200	\$0	\$0	\$0
3	\$22,523	\$26,467	\$20,717	\$0	\$0	\$0
2	\$14,710	\$17,286	\$13,530	\$0	\$0	\$1,326
1	\$7,206	\$8,468	\$6,628	\$801	\$749	\$650
0	\$0	\$0	\$0	\$0	\$0	\$0
Total I&DDC	\$252,655	\$296,907	\$232,398	\$801	\$749	\$1,975
Present Worth of Installation Costs	\$1,737,568	\$2,041,898	\$1,437,567	\$39,636	\$37,064	\$33,469

*Discount Rate is 4-1/8%

**If a cost is incurred between Dec-1 2019 and Dec-1 2020, it is said to be incurred in the base year

All costs are compounded or discounted to the base year (i.e. if a cost is incurred on Feb-1 2019, it accrues one year of interest)

Phase III Interest During Construction

Fargo-Moorhead Metro Feasibility Study

		Scheduled Construction Cost					
	ND E 35k	MN S 35	MN S 30	MN S 25	MN S 20	Rec ND	Rec MN
May-2012	\$72,786	\$71,106	\$66,007	\$61,971	\$57,073		
Dec-2012	\$145,571	\$142,213	\$132,013	\$123,942	\$114,147		
Dec-2013	\$145,571	\$142,213	\$132,013	\$123,942	\$114,147		
Dec-2014	\$145,571	\$142,213	\$132,013	\$123,942	\$114,147		
Dec-2015	\$145,571	\$142,213	\$132,013	\$123,942	\$114,147		
Dec-2016	\$145,571	\$142,213	\$132,013	\$123,942	\$114,147		
Dec-2017	\$145,571	\$142,213	\$132,013	\$123,942	\$114,147		\$17,121
Dec-2018	\$145,571	\$142,213	\$132,013	\$123,942	\$114,147	\$17,376	\$17,121
Dec-2019	\$145,571					\$17,376	
Nominal Total	\$1,237,355	\$1,066,597	\$990,099	\$929,562	\$856,101	\$34,753	\$34,243

		Compounding					
Years to base							
8	\$29,736	\$29,050	\$26,967	\$25,318	\$23,317	\$0	\$0
7	\$50,878	\$49,705	\$46,140	\$43,319	\$39,895	\$0	\$0
6	\$42,644	\$41,660	\$38,672	\$36,308	\$33,438	\$0	\$0
5	\$34,755	\$33,953	\$31,518	\$29,591	\$27,252	\$0	\$0
4	\$27,196	\$26,569	\$24,663	\$23,155	\$21,325	\$0	\$0
3	\$19,954	\$19,494	\$18,096	\$16,989	\$15,647	\$0	\$0
2	\$13,016	\$12,716	\$11,804	\$11,082	\$10,206	\$0	\$1,531
1	\$6,369	\$6,222	\$5,776	\$5,422	\$4,994	\$760	\$749
0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
Total I&DDC	\$224,548	\$219,368	\$203,635	\$191,184	\$176,075	\$760	\$2,280

Present Worth of							
Installation Costs	\$1,461,904	\$1,285,965	\$1,193,733	\$1,120,745	\$1,032,176	\$35,513	\$36,522

*Discount Rate is 4-3/8%

**If a cost is incurred between Dec-1 2019 and Dec-1 2020, it is said to be incurred in the base year

All costs are compounded or discounted to the base year (i.e. if a cost is incurred on Feb-1 2019, it accrues one year of interest)

EXHIBIT L
EAD, EAB, EEAD, & EEAB

EEAD by Reach (\$1,000's)	
Without Project Conditions (all analysis years) - Upstream & Downstream	
	EEAD*
South of Thompson	\$26
Climax MN&ND	\$48
Shelly MN&ND	\$110
Halstad MN&ND	\$159
Perley-Hendrum MN&ND	\$167
Georgetown MN&ND	\$193
Intermediate Downstream	\$59
Upstream - Inlet to Abercrombie	\$693
Total EEAD Downstream	\$763
Total EEAD Upstream	\$693
*EAD is constant for each analysis year, therefore EEAD = EAD	

EAD & EEAD by Reach (\$1,000's)
Without Project Conditions - Metro Area

Without Project Conditions - Metro Area								
Analysis Year	Fargo	West Fargo	Cass Co.	Moorhead & Clay Co.	Emergency	Other Infrastruture	Traffic	
EAD 2019	2019	\$150,316	\$15,360	\$7,909	\$12,858	\$7,739	\$291	\$4,029
EAD 2043	2043	\$123,634	\$12,962	\$26,706	\$10,615	\$6,311	\$237	\$3,290
EAD 2068	2068	\$102,990	\$10,896	\$34,724	\$8,876	\$5,239	\$197	\$2,728
EAD 2019	2019-2043	\$150,316	\$15,360	\$7,909	\$12,858	\$7,739	\$291	\$4,029
# years to next analysis year		24	24	24	24	24	24	24
Annual Change		-\$1,067	-\$96	\$752	-\$90	-\$57	-\$2	-\$30
Annual Discount Factor		0.9604	0.9604	0.9604	0.9604	0.9604	0.9604	0.9604
Present Worth of Stream		\$2,195,668	\$226,342	\$237,026	\$188,052	\$112,723	\$4,241	\$58,709
EAD 2043	2043-2068	\$123,634	\$12,962	\$26,706	\$10,615	\$6,311	\$237	\$3,290
# years to next analysis year		25	25	25	25	25	25	25
Annual Change		-\$826	-\$83	\$321	-\$70	-\$43	-\$2	-\$22
Annual Discount Factor		0.9604	0.9604	0.9604	0.9604	0.9604	0.9604	0.9604
Present Worth of Stream		\$702,391	\$73,879	\$181,890	\$60,387	\$35,812	\$1,346	\$18,660
Discount Rate		4.125%						
Total Present Worth		\$2,898,060	\$300,221	\$418,915	\$248,439	\$148,534	\$5,587	\$77,369
EEAD		\$137,806	\$14,276	\$19,920	\$11,814	\$7,063	\$266	\$3,679

EAD & EEAD by Reach (\$1,000's)
ND35k & ND w/Staging - Metro Area

Analysis Year		Fargo	West Fargo	Cass Co.	Moorhead & Clay Co.	Emergency	Other Infrastructure	Traffic
EAD 2019	2019	\$17,709	\$2,026	\$1,529	\$1,925	\$719	\$24	\$364
EAD 2043	2043	\$14,865	\$1,714	\$5,601	\$1,692	\$578	\$20	\$300
EAD 2068	2068	\$12,455	\$1,452	\$7,821	\$1,483	\$453	\$16	\$240
EAD 2019		\$17,709	\$2,026	\$1,529	\$1,925	\$719	\$24	\$364
# years to next analysis year		24	24	24	24	24	24	24
Annual Change	2019-2043	-\$114	-\$12	\$163	-\$9	-\$6	\$0	-\$3
Annual Discount Factor		0.9604	0.9604	0.9604	0.9604	0.9604	0.9604	0.9604
Present Worth of Stream	2019-2043	\$260,475	\$29,875	\$48,454	\$28,774	\$10,420	\$354	\$5,319
EAD 2043		\$14,865	\$1,714	\$5,601	\$1,692	\$578	\$20	\$300
# years to next analysis year		25	25	25	25	25	25	25
Annual Change	2043-2068	-\$96	-\$10	\$89	-\$8	-\$5	\$0	-\$2
Annual Discount Factor		0.9604	0.9604	0.9604	0.9604	0.9604	0.9604	0.9604
Present Worth of Stream	2043-2068	\$84,626	\$9,796	\$39,449	\$9,789	\$3,215	\$110	\$1,682
Discount Rate		4.125%						
Total Present Worth		\$345,101	\$39,671	\$87,903	\$38,563	\$13,635	\$464	\$7,000
EEAD		\$16,410	\$1,886	\$4,180	\$1,834	\$648	\$22	\$333

EAD & EEAD by Reach (\$1,000's)
MN35k - Metro Area

Analysis Year		Fargo	West Fargo	Cass Co.	Moorhead & Clay Co.	Emergency	Other Infrastructure	Traffic
EAD 2019	2019	\$17,834	\$2,875	\$4,626	\$2,008	\$704	\$28	\$402
EAD 2043	2043	\$15,255	\$2,668	\$8,652	\$1,777	\$584	\$23	\$339
EAD 2068	2068	\$12,960	\$2,341	\$12,603	\$1,560	\$463	\$18	\$273
EAD 2019		\$17,834	\$2,875	\$4,626	\$2,008	\$704	\$28	\$402
# years to next analysis year	2019-2043	24	24	24	24	24	24	24
Annual Change		-\$103	-\$8	\$161	-\$9	-\$5	\$0	-\$3
Annual Discount Factor		0.9604	0.9604	0.9604	0.9604	0.9604	0.9604	0.9604
Present Worth of Stream	2019-2043	\$264,030	\$43,819	\$96,727	\$30,083	\$10,314	\$405	\$5,918
EAD 2043		\$15,255	\$2,668	\$8,652	\$1,777	\$584	\$23	\$339
# years to next analysis year	2043-2068	25	25	25	25	25	25	25
Annual Change		-\$92	-\$13	\$158	-\$9	-\$5	\$0	-\$3
Annual Discount Factor		0.9604	0.9604	0.9604	0.9604	0.9604	0.9604	0.9604
Present Worth of Stream	2043-2068	\$87,277	\$15,446	\$62,200	\$10,289	\$3,262	\$129	\$1,902
Discount Rate		4.125%						
Total Present Worth		\$351,307	\$59,265	\$158,927	\$40,373	\$13,577	\$535	\$7,820
EEAD		\$16,705	\$2,818	\$7,557	\$1,920	\$646	\$25	\$372

EAB & EEAB by Reach (\$1,000's)
ND35k & ND w/Staging - Metro Area

Analysis Year		Fargo	West Fargo	Cass Co.	Moorhead & Clay Co.	Emergency	Other Infrastructure	Traffic
EAB 2019	2019	\$132,607	\$13,335	\$6,380	\$10,932	\$7,020	\$267	\$3,666
EAB 2043	2043	\$108,769	\$11,248	\$21,105	\$8,923	\$5,734	\$218	\$2,989
EAB 2068	2068	\$90,535	\$9,444	\$26,903	\$7,393	\$4,786	\$181	\$2,488
EAB 2019		\$132,607	\$13,335	\$6,380	\$10,932	\$7,020	\$267	\$3,666
# years to next analysis year		24	24	24	24	24	24	24
Annual Change	2019-2043	-\$954	-\$83	\$589	-\$80	-\$51	-\$2	-\$27
Annual Discount Factor		0.9604	0.9604	0.9604	0.9604	0.9604	0.9604	0.9604
Present Worth of Stream	2019-2043	\$1,935,193	\$196,467	\$188,572	\$159,277	\$102,303	\$3,887	\$53,390
EAB 2043		\$108,769	\$11,248	\$21,105	\$8,923	\$5,734	\$218	\$2,989
# years to next analysis year		25	25	25	25	25	25	25
Annual Change	2043-2068	-\$729	-\$72	\$232	-\$61	-\$38	-\$1	-\$20
Annual Discount Factor		0.9604	0.9604	0.9604	0.9604	0.9604	0.9604	0.9604
Present Worth of Stream	2043-2068	\$617,765	\$64,083	\$142,440	\$50,598	\$32,597	\$1,236	\$16,978
Discount Rate		4.125%						
Total Present Worth		\$2,552,958	\$260,550	\$331,012	\$209,875	\$134,900	\$5,123	\$70,368
EEAB		\$121,396	\$12,389	\$15,740	\$9,980	\$6,415	\$244	\$3,346

EAB & EEAB by Reach (\$1,000's)
MN35k - Metro Area

Analysis Year		Fargo	West Fargo	Cass Co.	Moorhead & Clay Co.	Emergency	Other Infrastruture	Traffic
EAB 2019	2019	\$132,482	\$12,486	\$3,283	\$10,850	\$7,035	\$264	\$3,627
EAB 2043	2043	\$108,379	\$10,294	\$18,054	\$8,838	\$5,727	\$214	\$2,951
EAB 2068	2068	\$90,029	\$8,555	\$22,121	\$7,316	\$4,776	\$178	\$2,455
EAB 2019		\$132,482	\$12,486	\$3,283	\$10,850	\$7,035	\$264	\$3,627
# years to next analysis year	2019-2043	24	24	24	24	24	24	24
Annual Change		-\$964	-\$88	\$591	-\$81	-\$52	-\$2	-\$27
Annual Discount Factor		0.9604	0.9604	0.9604	0.9604	0.9604	0.9604	0.9604
Present Worth of Stream	2019-2043	\$1,931,639	\$182,523	\$140,299	\$157,968	\$102,408	\$3,835	\$52,791
EAB 2043		\$108,379	\$10,294	\$18,054	\$8,838	\$5,727	\$214	\$2,951
# years to next analysis year	2043-2068	25	25	25	25	25	25	25
Annual Change		-\$734	-\$70	\$163	-\$61	-\$38	-\$1	-\$20
Annual Discount Factor		0.9604	0.9604	0.9604	0.9604	0.9604	0.9604	0.9604
Present Worth of Stream	2043-2068	\$615,114	\$58,433	\$119,689	\$50,098	\$32,549	\$1,217	\$16,758
Discount Rate		4.125%						
Total Present Worth		\$2,546,752	\$240,956	\$259,988	\$208,066	\$134,958	\$5,052	\$69,549
EEAB		\$121,101	\$11,458	\$12,363	\$9,894	\$6,417	\$240	\$3,307

EAD & EEAD by Categories (\$1,000's)
Without Project Conditions

Analysis Year		Residential	Commercial	Public	Farm	Emergency	Other Infrastruture	Traffic
EAD 2019	2019	\$92,191	\$82,994	\$10,553	\$705	\$7,739	\$291	\$4,029
EAD 2043	2043	\$82,046	\$82,618	\$8,675	\$579	\$6,311	\$237	\$3,290
EAD 2068	2068	\$71,556	\$78,209	\$7,236	\$486	\$5,239	\$197	\$2,728
EAD 2019		\$92,191	\$82,994	\$10,553	\$705	\$7,739	\$291	\$4,029
# years to next analysis year	2019-2043	24	24	24	24	24	24	24
Annual Change		-\$406	-\$15	-\$75	-\$5	-\$57	-\$2	-\$30
Annual Discount Factor		0.9604	0.9604	0.9604	0.9604	0.9604	0.9604	0.9604
Present Worth of Stream	2019-2043	\$1,384,038	\$1,298,639	\$154,117	\$10,293	\$112,723	\$4,241	\$58,709
EAD 2043		\$82,046	\$82,618	\$8,675	\$579	\$6,311	\$237	\$3,290
# years to next analysis year	2043-2068	25	25	25	25	25	25	25
Annual Change		-\$420	-\$176	-\$58	-\$4	-\$43	-\$2	-\$22
Annual Discount Factor		0.9604	0.9604	0.9604	0.9604	0.9604	0.9604	0.9604
Present Worth of Stream	2043-2068	\$473,880	\$492,063	\$49,306	\$3,296	\$35,812	\$1,346	\$18,660
Discount Rate		4.125%						
Total Present Worth		\$1,857,919	\$1,790,702	\$203,424	\$13,589	\$148,534	\$5,587	\$77,369
EEAD		\$88,300	\$85,100	\$9,700	\$600	\$7,100	\$300	\$3,700
Total EEAD		\$194,800						

EEAD, EEAB & Induced Damage - Upstream and Downstream (\$1,000's)

	EEAD	Induced Damage	EEAB
	Upstream		
Without	\$693 -	-	
ND-E-35k	\$729	\$36 -	
ND w/Staging	\$183 -		\$509
MN-S-35k	\$729	\$36 -	
	Downstream		
Without	\$763 -	-	
ND-E-35k	\$879	\$116 -	
ND w/Staging	\$646 -		\$117
MN-S-35k	\$879	\$116 -	
	Total		
Without	\$1,456	\$0	\$0
ND-E-35k	\$1,608	\$153	\$0
ND w/Staging	\$829	\$0	\$627
MN-S-35k	\$1,608	\$153	\$0

EAD & EEAD - Future Development (\$1,000's)

Analysis Year	Without Project Conditions	Without - Existing Economic Conditions
2019	\$198,502	\$189,803
2043	\$183,755	\$156,969
2068	\$165,650	\$131,534
Analysis Year	Net Change EAD (\$1,000's) Without - Existing Economic Conditions	
2019	\$8,699	
2043	\$26,786	
2068	\$34,116	
Annual Equiv.	\$194,800.00	\$167,700.00

Analysis Year		Without Project Conditions	Without - Existing Economic Conditions	Additional Damage Due to Development (\$)	Additional Damage Due to Development (%)
EAD 2019	2019	\$198,502	\$189,803	\$8,699	4.4%
EAD 2043	2043	\$183,755	\$156,969	\$26,786	14.6%
EAD 2068	2068	\$165,650	\$131,534	\$34,116	20.6%
EAD 2019	2019-2043	\$198,502	\$189,803	\$8,699	4.4%
# years to next analysis year		24	24		
Annual Change		-\$590	-\$1,313		
Annual Discount Factor		0.9604	0.9604		
Present Worth of Stream		\$3,022,753	\$2,667,575	\$355,177	11.8%
EAD 2043	2043-2068	\$183,755	\$156,969	\$26,786	14.6%
# years to next analysis year		25	25		
Annual Change		-\$724	-\$1,017		
Annual Discount Factor		0.9604	0.9604		
Present Worth of Stream		\$1,074,362	\$858,247	\$216,115	20.1%
Discount Rate		4.125%			
Total Present Worth		\$4,097,115	\$3,525,822		
EEAD		\$194,800	\$167,700	\$27,100	13.9%

EXHIBIT M
Benefits Uncertainty & Project Performance

Distribution of EEAB - Benefits Needed for Unity BCR (\$1,000's)

<u>Plan Name</u>	<u>Annual Costs</u>	<u>EEAB</u> <u>Needed for</u> <u>BCR of 1.0 *</u>				
		<u>Probability that FRM EEAB Exceeds Indicated Values</u>				
			<u>0.75</u>		<u>0.5</u>	<u>0.25</u>
ND w/Staging	\$ 97,894	\$ 85,877	\$ 89,500	\$	140,900	\$ 212,500
ND-E-35k	\$ 78,627	\$ 67,650	\$ 89,500	\$	140,900	\$ 212,500
MN Short 35k	\$ 67,788	\$ 60,134	\$ 89,700	\$	142,300	\$ 215,700

* Difference between this figure and annual costs is other benefits (flood insurance cost savings and floodproofing cost savings)

Note: Does not include Recreation costs and benefits

EAD & EEAD - Mean Values (\$1,000's)

Analysis Year		Without Project	ND w/Staging	ND-E-35k	MN-S-45k	MN-S-40k	MN-S-35k	MN-S-30k	MN-S-25k	MN-S-20k
EAD 2019	###	\$198,502	\$24,295	\$24,295	\$20,319	\$23,901	\$28,476	\$35,828	\$40,833	\$57,159
EAD 2043	###	\$183,755	\$24,770	\$24,770	\$22,313	\$25,354	\$29,299	\$35,995	\$42,284	\$54,719
EAD 2068	###	\$165,650	\$23,920	\$23,920	\$25,050	\$26,750	\$30,219	\$35,887	\$42,501	\$53,500
EAD 2019		\$198,502	\$24,295	\$24,295	\$20,319	\$23,901	\$28,476	\$35,828	\$40,833	\$57,159
# years to next analysis year	2019-2043	24	24	24	24	24	24	24	24	24
Annual Change	2019-2043	-\$590	\$19	\$19	\$80	\$58	\$33	\$7	\$58	-\$98
Annual Discount Factor	2019-2043	0.9604	0.9604	0.9604	0.9604	0.9604	0.9604	0.9604	0.9604	0.9604
Present Worth of Stream	2019-2043	\$3,022,753	\$368,471	\$368,471	\$330,488	\$383,379	\$451,298	\$562,594	\$648,770	\$881,270
EAD 2043		\$183,755	\$24,770	\$24,770	\$22,313	\$25,354	\$29,299	\$35,995	\$42,284	\$54,719
# years to next analysis year	2043-2068	25	25	25	25	25	25	25	25	25
Annual Change	2043-2068	-\$724	-\$34	-\$34	\$110	\$56	\$37	-\$4	\$9	-\$49
Annual Discount Factor	2043-2068	0.9604	0.9604	0.9604	0.9604	0.9604	0.9604	0.9604	0.9604	0.9604
Present Worth of Stream	2043-2068	\$1,074,362	\$142,777	\$142,777	\$142,389	\$157,652	\$180,506	\$218,767	\$257,818	\$330,016
Discount Rate		4.125%								
Total Present Worth		\$4,097,115	\$511,248	\$511,248	\$472,877	\$541,031	\$631,804	\$781,361	\$906,588	\$1,211,286
EEAD		\$194,800	\$24,300	\$24,300	\$22,500	\$25,700	\$30,000	\$37,200	\$43,100	\$57,600
*Extra year of discounting added for North Dakota Alternatives										

EAB & EEAB - Mean Values (\$1,000's)

Analysis Year		ND w/Staging	ND-E-35k	MN-S-45k	MN-S-40k	MN-S-35k	MN-S-30k	MN-S-25k	MN-S-20k
EAB 2019	###	\$174,207	\$174,207	\$178,183	\$174,601	\$170,026	\$162,675	\$157,669	\$141,343
EAB 2043	###	\$158,986	\$158,986	\$161,442	\$158,401	\$154,456	\$147,760	\$141,471	\$129,036
EAB 2068	###	\$141,730	\$141,730	\$140,600	\$138,900	\$135,431	\$129,763	\$123,149	\$112,150
EAB 2019		\$174,207	\$174,207	\$178,183	\$174,601	\$170,026	\$162,675	\$157,669	\$141,343
# years to next analysis year	2019-2043	24	24	24	24	24	24	24	24
Annual Change		-\$609	-\$609	-\$670	-\$648	-\$623	-\$597	-\$648	-\$492
Annual Discount Factor		0.9604	0.9604	0.9604	0.9604	0.9604	0.9604	0.9604	0.9604
Present Worth of Stream		\$2,534,533	\$2,534,533	\$2,692,265	\$2,639,373	\$2,571,455	\$2,460,159	\$2,373,983	\$2,141,482
EAB 2043		\$158,986	\$158,986	\$161,442	\$158,401	\$154,456	\$147,760	\$141,471	\$129,036
# years to next analysis year	2043-2068	25	25	25	25	25	25	25	25
Annual Change		-\$690	-\$690	-\$834	-\$780	-\$761	-\$720	-\$733	-\$675
Annual Discount Factor		0.9604	0.9604	0.9604	0.9604	0.9604	0.9604	0.9604	0.9604
Present Worth of Stream		\$889,023	\$889,023	\$931,973	\$916,710	\$893,855	\$855,595	\$816,544	\$744,346
Discount Rate		4.125%							
Total Present Worth		\$3,423,556	\$3,423,556	\$3,624,238	\$3,556,083	\$3,465,310	\$3,315,754	\$3,190,527	\$2,885,828
EEAB		\$162,800	\$162,800	\$172,300	\$169,100	\$164,800	\$157,700	\$151,700	\$137,200
*Extra year of discounting added for North Dakota Alternatives									

EAB and EEAB - 75% Exceedance Values (\$1,000's)

Analysis Year		ND w/Staging	ND-E-35k	MN-S-45k	MN-S-40k	MN-S-35k	MN-S-30k	MN-S-25k	MN-S-20k
EAB 2019	###	\$101,114	\$101,114	\$101,299	\$99,872	\$97,851	\$94,400	\$91,990	\$83,616
EAB 2043	###	\$84,435	\$84,435	\$83,407	\$82,408	\$81,009	\$78,393	\$75,700	\$69,984
EAB 2068	###	\$68,860	\$68,860	\$66,635	\$66,124	\$64,977	\$63,008	\$60,612	\$56,056
EAB 2019		\$101,114	\$101,114	\$101,299	\$99,872	\$97,851	\$94,400	\$91,990	\$83,616
# years to next analysis year	2019-2043	24	24	24	24	24	24	24	24
Annual Change		-\$667	-\$667	-\$716	-\$699	-\$674	-\$640	-\$652	-\$545
Annual Discount Factor		0.9604	0.9604	0.9604	0.9604	0.9604	0.9604	0.9604	0.9604
Present Worth of Stream		\$1,425,792	\$1,425,792	\$1,480,214	\$1,460,418	\$1,432,482	\$1,383,406	\$1,343,936	\$1,228,658
EAB 2043		\$84,435	\$84,435	\$83,407	\$82,408	\$81,009	\$78,393	\$75,700	\$69,984
# years to next analysis year	2043-2068	25	25	25	25	25	25	25	25
Annual Change		-\$623	-\$623	-\$671	-\$651	-\$641	-\$615	-\$604	-\$557
Annual Discount Factor		0.9604	0.9604	0.9604	0.9604	0.9604	0.9604	0.9604	0.9604
Present Worth of Stream		\$457,261	\$457,261	\$466,975	\$462,076	\$454,171	\$439,818	\$424,150	\$392,173
Discount Rate		4.125%							
Total Present Worth		\$1,883,054	\$1,883,054	\$1,947,189	\$1,922,494	\$1,886,654	\$1,823,224	\$1,768,086	\$1,620,831
EEAB		\$89,500	\$89,500	\$92,600	\$91,400	\$89,700	\$86,700	\$84,100	\$77,100
*Extra year of discounting added for North Dakota Alternatives									

EAB and EEAB - 50% Exceedance Values (\$1,000's)

Analysis Year		ND w/Staging	ND-E-35k	MN-S-45k	MN-S-40k	MN-S-35k	MN-S-30k	MN-S-25k	MN-S-20k
EAB 2019	###	\$154,130	\$154,130	\$156,587	\$153,798	\$150,156	\$144,381	\$140,170	\$126,487
EAB 2043	###	\$135,722	\$135,722	\$136,378	\$134,201	\$131,473	\$126,272	\$121,356	\$111,647
EAB 2068	###	\$116,619	\$116,619	\$114,618	\$113,558	\$111,150	\$107,085	\$102,141	\$93,883
EAB 2019		\$154,130	\$154,130	\$156,587	\$153,798	\$150,156	\$144,381	\$140,170	\$126,487
# years to next analysis year	2019-2043	24	24	24	24	24	24	24	24
Annual Change		-\$736	-\$736	-\$808	-\$784	-\$747	-\$724	-\$753	-\$594
Annual Discount Factor		0.9604	0.9604	0.9604	0.9604	0.9604	0.9604	0.9604	0.9604
Present Worth of Stream		\$2,213,894	\$2,213,894	\$2,332,898	\$2,292,862	\$2,241,273	\$2,154,204	\$2,083,958	\$1,893,383
EAB 2043		\$135,722	\$135,722	\$136,378	\$134,201	\$131,473	\$126,272	\$121,356	\$111,647
# years to next analysis year	2043-2068	25	25	25	25	25	25	25	25
Annual Change		-\$764	-\$764	-\$870	-\$826	-\$813	-\$767	-\$769	-\$711
Annual Discount Factor		0.9604	0.9604	0.9604	0.9604	0.9604	0.9604	0.9604	0.9604
Present Worth of Stream		\$748,785	\$748,785	\$777,240	\$766,694	\$750,868	\$721,967	\$691,985	\$636,415
Discount Rate		4.125%							
Total Present Worth		\$2,962,679	\$2,962,679	\$3,110,138	\$3,059,556	\$2,992,140	\$2,876,170	\$2,775,943	\$2,529,798
EEAB		\$140,900	\$140,900	\$147,900	\$145,500	\$142,300	\$136,800	\$132,000	\$120,300
*Extra year of discounting added for North Dakota Alternatives									

EAB and EEAB - 25% Exceedance Values (\$1,000's)

Analysis Year		ND w/Staging	ND-E-35k	MN-S-45k	MN-S-40k	MN-S-35k	MN-S-30k	MN-S-25k	MN-S-20k
EAB 2019	###	\$225,609	\$225,609	\$231,499	\$226,744	\$220,742	\$210,948	\$204,366	\$182,862
EAB 2043	###	\$208,639	\$208,639	\$212,503	\$208,498	\$203,345	\$194,367	\$186,070	\$169,506
EAB 2068	###	\$187,822	\$187,822	\$187,008	\$184,706	\$180,061	\$172,492	\$163,722	\$149,026
EAB 2019		\$225,609	\$225,609	\$231,499	\$226,744	\$220,742	\$210,948	\$204,366	\$182,862
# years to next analysis year	2019-2043	24	24	24	24	24	24	24	24
Annual Change		-\$679	-\$679	-\$760	-\$730	-\$696	-\$663	-\$732	-\$534
Annual Discount Factor		0.9604	0.9604	0.9604	0.9604	0.9604	0.9604	0.9604	0.9604
Present Worth of Stream		\$3,298,224	\$3,298,224	\$3,514,413	\$3,444,391	\$3,355,418	\$3,206,809	\$3,093,323	\$2,785,968
EAB 2043		\$208,639	\$208,639	\$212,503	\$208,498	\$203,345	\$194,367	\$186,070	\$169,506
# years to next analysis year	2043-2068	25	25	25	25	25	25	25	25
Annual Change		-\$833	-\$833	-\$1,020	-\$952	-\$931	-\$875	-\$894	-\$819
Annual Discount Factor		0.9604	0.9604	0.9604	0.9604	0.9604	0.9604	0.9604	0.9604
Present Worth of Stream		\$1,170,921	\$1,170,921	\$1,231,424	\$1,211,171	\$1,181,044	\$1,129,820	\$1,078,190	\$981,916
Discount Rate		4.125%							
Total Present Worth		\$4,469,145	\$4,469,145	\$4,745,838	\$4,655,563	\$4,536,463	\$4,336,629	\$4,171,513	\$3,767,883
EEAB		\$212,500	\$212,500	\$225,700	\$221,400	\$215,700	\$206,200	\$198,400	\$179,200
*Extra year of discounting added for North Dakota Alternatives									

Project Performance by Reach (Target Stages - Annual Exceedance Probabilities - Long-Term Risk - Conditional Non-Exceedance Probabilities)

Existing Conditions															
Reach	Index River Mile	Top of	Target	Target Stage Annual Exceedance Probability		Long-Term Risk (years)			Conditional Non-Exceedance Probability by Events						
		Levee	Stage	Median	Expected	10	30	50	10%	4%	2%	1%	0.40%	0.20%	
Fargo North End	442.93	---	893.80		9.00%	9.44%	62.91%	91.62%	99.30%	59.32%	5.51%	0.38%	0.02%	0.00%	0.00%
Ridgewood	447.78	898	898.00		3.42%	3.98%	33.38%	63.78%	86.88%	98.38%	57.60%	17.60%	3.45%	0.27%	0.03%
Near North	449.61	---	897.30		6.33%	7.02%	51.71%	83.79%	97.37%	83.86%	15.72%	1.54%	0.08%	0.00%	0.00%
Downtown North	451.37	---	898.10		6.56%	7.24%	52.82%	84.71%	97.66%	82.52%	13.31%	1.09%	0.04%	0.00%	0.00%
Downtown South	452.25	902.2	902.20		2.75%	3.17%	27.52%	55.27%	79.99%	99.76%	73.76%	26.66%	5.16%	0.31%	0.02%
Near South	452.7	904	904.00		3.33%	3.66%	31.09%	60.57%	84.46%	92.42%	73.16%	43.59%	16.49%	2.44%	0.37%
Lindenwood Area	454.1	---	902.07		3.65%	4.13%	34.41%	65.15%	87.86%	98.86%	53.87%	12.25%	1.37%	0.03%	0.00%
Z_Other	650		900.61		4.69%	5.19%	41.33%	73.64%	93.05%	96.09%	34.74%	5.19%	0.37%	0.00%	0.00%
Fargo South															
From RRN	460.28	---	903.08		5.75%	6.30%	47.86%	80.37%	96.14%	90.42%	20.15%	2.02%	0.09%	0.00%	0.00%
From Sheyenne	172308	---	904.54		9.96%	11.04%	68.96%	94.63%	99.71%	50.61%	0.00%	0.00%	0.00%	0.00%	0.00%
West Fargo															
WF Downtown	451.37	---	902.00		2.03%	2.28%	20.60%	43.83%	68.45%	99.95%	88.33%	50.21%	17.43%	2.42%	0.35%
WF South	172308	---	904.44		11.65%	12.54%	73.82%	96.49%	99.88%	35.31%	0.00%	0.00%	0.00%	0.00%	0.00%
Harwood															
Harwood Red	432.84	---	887.92		12.83%	13.58%	76.75%	97.39%	99.93%	23.61%	0.67%	0.02%	0.00%	0.00%	0.00%
Harwood Sheyenne	67984	---	887.30		17.86%	17.91%	86.10%	99.28%	99.99%	4.79%	0.00%	0.00%	0.00%	0.00%	0.00%
Cass County															
ANorth (RRN)	440.31	---	890.21		16.36%	16.97%	84.43%	99.04%	99.99%	6.84%	0.02%	0.00%	0.00%	0.00%	0.00%
ASouth (RRN)	465.1	---	899.64		20.05%	20.06%	89.34%	99.63%	100.00%	1.70%	0.00%	0.00%	0.00%	0.00%	0.00%
BNorth (RRN)	440.31	---	886.75		25.47%	26.00%	95.07%	99.95%	100.00%	0.03%	0.00%	0.00%	0.00%	0.00%	0.00%
BSouth (RRN)	465.1	---	901.11		15.23%	15.96%	82.43%	98.71%	99.98%	9.42%	0.02%	0.00%	0.00%	0.00%	0.00%
ASheyenne	172308	---	902.25		47.94%	47.74%	99.85%	100.00%	100.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
ShySA	166	---	890.01		5.40%	5.97%	45.96%	78.53%	95.39%	88.83%	26.66%	1.02%	0.00%	0.00%	0.00%
Moorhead															
Kragnes	434.61	---	889.57		10.81%	11.12%	69.25%	94.76%	99.73%	42.49%	3.11%	0.26%	0.02%	0.00%	0.00%
Oakport	440.31	900.5	900.50		0.24%	0.34%	3.33%	8.12%	15.57%	100.00%	99.99%	99.35%	93.83%	68.38%	41.94%
North of Moorhead	442.93	---	892.83		11.31%	11.82%	71.57%	95.69%	99.81%	35.46%	1.20%	0.04%	0.00%	0.00%	0.00%
Moorhead North	449.61	---	898.17		4.97%	5.48%	43.11%	75.59%	94.04%	93.94%	32.08%	5.26%	0.47%	0.01%	0.00%
Moorhead Central	452.7	---	900.67		4.62%	5.12%	40.90%	73.15%	92.79%	96.36%	35.84%	5.50%	0.40%	0.00%	0.00%
Moorhead South	460.28	---	902.22		7.06%	7.71%	55.17%	86.55%	98.19%	78.82%	9.41%	0.53%	0.01%	0.00%	0.00%
South of Moorhead	468.9	---	905.54		9.35%	9.84%	64.50%	92.49%	99.44%	55.64%	2.59%	0.07%	0.00%	0.00%	0.00%
Downstream															
Georgetown MN&ND - XS 414.98	414.98	---	879.06		12.89%	13.37%	76.18%	97.23%	99.92%	24.56%	2.49%	0.22%	0.00%	0.00%	0.00%
Halstad MN&ND - XS 397.8	397.80	---	872.91		8.81%	9.31%	62.38%	91.32%	99.25%	59.55%	6.08%	0.24%	0.00%	0.00%	0.00%
Perley-Hendrum MN&ND - XS 381.71	381.71	---	867.25		7.69%	8.24%	57.69%	88.36%	98.64%	64.34%	19.60%	5.37%	1.63%	0.28%	0.00%
Shelly MN&ND - XS 359.73	359.73	---	860.15		4.53%	4.91%	39.55%	71.59%	91.93%	96.21%	40.41%	9.73%	2.01%	0.34%	0.00%
Climax MN&ND - XS 335.01	335.01	---	849.35		5.40%	5.73%	44.56%	77.11%	94.76%	92.62%	28.84%	5.95%	0.81%	0.00%	0.00%
South of Thompson - XS 324.41	324.41	---	846.59		3.80%	4.13%	34.39%	65.14%	87.85%	98.65%	53.50%	15.99%	3.30%	0.57%	0.18%
Intermediate - XS 423.96	423.96	---	882.00		14.65%	15.12%	80.59%	98.34%	99.97%	11.97%	0.65%	0.00%	0.00%	0.00%	0.00%
Upstream															
Upstream_Red	500.01	---	920.28		3.73%	4.01%	33.57%	64.03%	87.06%	98.92%	54.51%	17.40%	7.54%	1.09%	0.27%
Upstream_WR	32.12	---	924.42		7.50%	7.90%	56.10%	87.23%	98.37%	70.48%	13.16%	1.33%	0.00%	0.00%	0.00%

Project Performance by Reach (Target Stages - Annual Exceedance Probabilities - Long-Term Risk - Conditional Non-Exceedance Probabilities)

ND w/Staging - LPP															
				Target Stage Annual Exceedance Probability		Long-Term Risk (years)			Conditional Non-Exceedance Probability by Events						
Reach	Index River Mile	Top of Levee	Target Stage	Median	Expected	10	30	50	10%	4%	2%	1%	0.40%	0.20%	
Fargo North End	442.93	---	893.80		0.42%	0.55%	5.36%	12.87%	24.09%	100.00%	99.98%	98.70%	86.72%	44.55%	17.08%
Ridgewood	447.78	898	898.00		0.23%	0.29%	2.89%	7.07%	13.64%	99.99%	100.00%	99.84%	96.72%	72.54%	41.32%
Near North	449.61	---	897.30		0.33%	0.43%	4.17%	10.09%	19.17%	99.99%	100.00%	99.48%	92.57%	56.99%	25.64%
Downtown North	451.37	---	898.10		0.33%	0.43%	4.22%	10.23%	19.41%	99.99%	100.00%	99.46%	92.34%	56.18%	24.89%
Downtown South	452.25	902.2	902.20		0.20%	0.25%	2.47%	6.07%	11.77%	99.99%	100.00%	99.91%	97.74%	77.38%	47.11%
Near South	452.7	904	904.00		0.32%	0.39%	3.82%	9.27%	17.69%	99.52%	99.50%	99.26%	96.29%	77.18%	50.71%
Lindenwood Area	454.1	---	902.07		0.24%	0.30%	2.96%	7.23%	13.94%	99.99%	100.00%	99.84%	96.69%	71.72%	39.78%
Z_Other	650	---	900.61		0.27%	0.35%	3.42%	8.34%	15.98%	99.99%	100.00%	99.73%	95.34%	65.74%	33.27%
Fargo South															
From RRN	460.28	---	903.08		0.31%	0.40%	3.93%	9.53%	18.15%	99.98%	100.00%	99.59%	93.66%	59.85%	27.83%
From Sheyenne	172308	---	904.54		0.01%	0.01%	0.10%	0.25%	0.50%	99.95%	99.97%	99.97%	99.97%	99.95%	99.95%
West Fargo															
WF Downtown	451.37	---	902.00		0.16%	0.20%	1.95%	4.81%	9.40%	99.99%	100.00%	99.96%	98.64%	83.57%	56.62%
WF South	172308	---	904.44		0.01%	0.01%	0.10%	0.25%	0.50%	99.95%	99.97%	99.97%	99.97%	99.95%	99.95%
Harwood															
Harwood Red	432.84	---	887.92		1.04%	2.08%	18.97%	40.89%	65.06%	98.05%	87.14%	67.90%	39.64%	10.76%	2.68%
Harwood Sheyenne	67984	---	887.30		1.58%	1.73%	16.05%	35.43%	58.31%	99.96%	98.53%	87.54%	0.00%	0.00%	0.00%
Cass County															
ANorth (RRN)	440.31	---	890.21		0.93%	1.81%	16.66%	36.60%	59.80%	98.11%	91.62%	75.84%	44.24%	10.60%	2.18%
ASouth (RRN)	465.1	---	899.64		0.76%	1.10%	10.46%	24.13%	42.44%	99.25%	98.95%	92.44%	63.41%	17.70%	3.97%
BNorth (RRN)	440.31	---	886.75		20.28%	20.60%	90.04%	99.69%	100.00%	0.14%	0.00%	0.00%	0.00%	0.00%	0.00%
BSouth (RRN)	465.1	---	901.11		0.59%	0.76%	7.31%	17.30%	31.60%	99.98%	99.91%	96.64%	75.43%	27.82%	7.77%
ASheyenne	172308	---	902.25		31.35%	31.49%	97.72%	99.99%	100.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
ShySA	166	---	890.01		1.53%	1.71%	15.86%	35.06%	57.83%	99.96%	97.58%	89.18%	0.00%	0.00%	0.00%
Moorhead															
Kragnes	434.61	---	889.57		0.63%	0.91%	8.77%	20.51%	36.81%	99.90%	98.74%	92.13%	68.97%	26.24%	8.24%
Oakport	440.31	900.5	900.50		0.04%	0.04%	0.39%	0.98%	1.95%	100.00%	100.00%	100.00%	99.95%	98.31%	91.39%
North of Moorhead	442.93	---	892.83		0.53%	0.69%	6.73%	15.99%	29.42%	99.99%	99.90%	97.15%	78.83%	32.83%	10.51%
Moorhead North	449.61	---	898.17		0.28%	0.36%	3.54%	8.62%	16.49%	99.99%	100.00%	99.69%	94.89%	64.34%	32.12%
Moorhead Central	452.7	---	900.67		0.27%	0.34%	3.38%	8.24%	15.80%	99.99%	100.00%	99.74%	95.43%	66.04%	33.60%
Moorhead South	460.28	---	902.22		0.35%	0.45%	4.43%	10.70%	20.26%	99.98%	100.00%	99.40%	91.60%	53.85%	22.88%
South of Moorhead	468.9	---	905.54		0.41%	0.53%	5.13%	12.33%	23.15%	99.98%	99.99%	99.04%	88.34%	46.31%	17.42%
Downstream															
Georgetown MN&ND - XS 414.98	414.98	---	879.06		11.59%	12.27%	72.99%	96.21%	99.86%	36.39%	3.64%	0.21%	0.00%	0.00%	0.00%
Halstad MN&ND - XS 397.8	397.80	---	872.91		7.47%	7.93%	56.25%	87.34%	98.40%	76.32%	8.34%	0.28%	0.00%	0.00%	0.00%
Perley-Hendrum MN&ND - XS 381.71	381.71	---	867.25		7.38%	8.03%	56.69%	87.65%	98.48%	67.85%	19.01%	4.28%	1.19%	0.21%	0.00%
Shelly MN&ND - XS 359.73	359.73	---	860.15		4.59%	4.97%	39.93%	72.04%	92.18%	96.00%	39.44%	9.11%	2.06%	0.35%	0.00%
Climax MN&ND - XS 335.01	335.01	---	849.35		5.51%	5.83%	45.14%	77.71%	95.03%	92.18%	27.45%	5.44%	0.88%	0.14%	0.00%
South of Thompson - XS 324.41	324.41	---	846.59		3.93%	4.24%	35.16%	66.14%	88.53%	98.49%	51.25%	14.67%	3.47%	0.63%	0.19%
Intermediate - XS 423.96	423.96	---	882.00		6.04%	6.12%	46.81%	79.36%	95.74%	97.23%	20.86%	2.29%	0.41%	0.00%	0.00%
Upstream															
Upstream_Red	500.01	---	920.28		6.88%	7.25%	52.90%	84.78%	97.68%	68.54%	27.11%	10.24%	3.93%	0.81%	0.24%
Upstream_WR	32.12	---	924.42		7.54%	7.90%	56.09%	87.23%	98.37%	70.69%	12.88%	1.22%	0.00%	0.00%	0.00%

Project Performance by Reach (Target Stages - Annual Exceedance Probabilities - Long-Term Risk - Conditional Non-Exceedance Probabilities)

ND35k

				Target Stage Annual Exceedance Probability		Long-Term Risk (years)			Conditional Non-Exceedance Probability by Events						
Reach	Index River Mile	Top of Levee	Target Stage	Median	Expected	10	30	50	10%	4%	2%	1%	0.40%	0.20%	
Fargo North End	442.93	---	893.80		0.42%	0.55%	5.36%	12.87%	24.09%	100.00%	99.98%	98.70%	86.72%	44.55%	17.08%
Ridgewood	447.78	898	898.00		0.23%	0.29%	2.89%	7.07%	13.64%	99.99%	100.00%	99.84%	96.72%	72.54%	41.32%
Near North	449.61	---	897.30		0.33%	0.43%	4.17%	10.09%	19.17%	99.99%	100.00%	99.48%	92.57%	56.99%	25.64%
Downtown North	451.37	---	898.10		0.33%	0.43%	4.22%	10.23%	19.41%	99.99%	100.00%	99.46%	92.34%	56.18%	24.89%
Downtown South	452.25	902.2	902.20		0.20%	0.25%	2.47%	6.07%	11.77%	99.99%	100.00%	99.91%	97.74%	77.38%	47.11%
Near South	452.7	904	904.00		0.32%	0.39%	3.82%	9.27%	17.69%	99.52%	99.50%	99.26%	96.29%	77.18%	50.71%
Lindenwood Area	454.1	---	902.07		0.24%	0.30%	2.96%	7.23%	13.94%	99.99%	100.00%	99.84%	96.69%	71.72%	39.78%
Z_Other	650		900.61		0.27%	0.35%	3.42%	8.34%	15.98%	99.99%	100.00%	99.73%	95.34%	65.74%	33.27%
Fargo South															
From RRN	460.28	---	903.08		0.31%	0.40%	3.93%	9.53%	18.15%	99.98%	100.00%	99.59%	93.66%	59.85%	27.83%
From Sheyenne	172308	---	904.54		0.01%	0.01%	0.10%	0.25%	0.50%	99.95%	99.97%	99.97%	99.97%	99.95%	99.95%
West Fargo															
WF Downtown	451.37	---	902.00		0.16%	0.20%	1.95%	4.81%	9.40%	99.99%	100.00%	99.96%	98.64%	83.57%	56.62%
WF South	172308	---	904.44		0.01%	0.01%	0.10%	0.25%	0.50%	99.95%	99.97%	99.97%	99.97%	99.95%	99.95%
Harwood															
Harwood Red	432.84		887.92		1.04%	2.08%	18.97%	40.89%	65.06%	98.05%	87.14%	67.90%	39.64%	10.76%	2.68%
Harwood Sheyenne	67984		887.30		1.58%	1.73%	16.05%	35.43%	58.31%	99.96%	98.53%	87.54%	0.00%	0.00%	0.00%
Cass County															
ANorth (RRN)	440.31	---	890.21		0.93%	1.81%	16.66%	36.60%	59.80%	98.11%	91.62%	75.84%	44.24%	10.60%	2.18%
ASouth (RRN)	465.1	---	899.64		0.76%	1.10%	10.46%	24.13%	42.44%	99.25%	98.95%	92.44%	63.41%	17.70%	3.97%
BNorth (RRN)	440.31	---	886.75		20.28%	20.60%	90.04%	99.69%	100.00%	0.14%	0.00%	0.00%	0.00%	0.00%	0.00%
BSouth (RRN)	465.1	---	901.11		0.59%	0.76%	7.31%	17.30%	31.60%	99.98%	99.91%	96.64%	75.43%	27.82%	7.77%
ASheyenne	172308	---	902.25		31.35%	31.49%	97.72%	99.99%	100.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
ShySA	166	---	890.01		1.53%	1.71%	15.86%	35.06%	57.83%	99.96%	97.58%	89.18%	0.00%	0.00%	0.00%
Moorhead															
Kragnes	434.61	---	889.57		0.63%	0.91%	8.77%	20.51%	36.81%	99.90%	98.74%	92.13%	68.97%	26.24%	8.24%
Oakport	440.31	900.5	900.50		0.04%	0.04%	0.39%	0.98%	1.95%	100.00%	100.00%	100.00%	99.95%	98.31%	91.39%
North of Moorhead	442.93	---	892.83		0.53%	0.69%	6.73%	15.99%	29.42%	99.99%	99.90%	97.15%	78.83%	32.83%	10.51%
Moorhead North	449.61	---	898.17		0.28%	0.36%	3.54%	8.62%	16.49%	99.99%	100.00%	99.69%	94.89%	64.34%	32.12%
Moorhead Central	452.7	---	900.67		0.27%	0.34%	3.38%	8.24%	15.80%	99.99%	100.00%	99.74%	95.43%	66.04%	33.60%
Moorhead South	460.28	---	902.22		0.35%	0.45%	4.43%	10.70%	20.26%	99.98%	100.00%	99.40%	91.60%	53.85%	22.88%
South of Moorhead	468.9	---	905.54		0.41%	0.53%	5.13%	12.33%	23.15%	99.98%	99.99%	99.04%	88.34%	46.31%	17.42%
Downstream															
Georgetown MN&ND - XS 414.98	414.98	---	879.06		13.59%	14.13%	78.21%	97.78%	99.95%	13.08%	0.23%	0.00%	0.00%	0.00%	0.00%
Halstad MN&ND - XS 397.8	397.80	---	872.91		10.12%	10.23%	66.02%	93.27%	99.55%	48.25%	2.34%	0.00%	0.00%	0.00%	0.00%
Perley-Hendrum MN&ND - XS 381.71	381.71	---	867.25		8.73%	8.97%	60.94%	90.47%	99.09%	58.41%	11.72%	1.78%	0.29%	0.00%	0.00%
Shelly MN&ND - XS 359.73	359.73	---	860.15		5.14%	5.53%	43.37%	75.86%	94.17%	93.27%	31.57%	6.52%	1.24%	0.28%	0.00%
Climax MN&ND - XS 335.01	335.01	---	849.35		5.97%	6.27%	47.66%	80.18%	96.07%	89.24%	22.75%	4.08%	0.51%	0.00%	0.00%
South of Thompson - XS 324.41	324.41	---	846.59		4.32%	4.65%	37.85%	69.55%	90.73%	97.56%	44.29%	11.22%	2.03%	0.44%	0.17%
Intermediate - XS 423.96	423.96	---	882.00		15.40%	15.92%	82.34%	98.69%	99.98%	2.32%	0.00%	0.00%	0.00%	0.00%	0.00%
Upstream															
Upstream_Red	500.01	---	920.28		3.76%	4.05%	33.83%	64.38%	87.31%	98.78%	53.88%	17.08%	7.58%	1.10%	0.28%
Upstream_WR	32.12	---	924.42		8.10%	8.32%	58.04%	88.60%	98.70%	64.63%	11.74%	1.39%	0.00%	0.00%	0.00%

Project Performance by Reach (Target Stages - Annual Exceedance Probabilities - Long-Term Risk - Conditional Non-Exceedance Probabilities)

MN35k - FCP

				Target Stage Annual Exceedance											
				Probability		Long-Term Risk (years)			Conditional Non-Exceedance Probability by Events						
Reach	Index River Mile	Top of Levee	Target Stage	Median	Expected	10	30	50	10%	4%	2%	1%	0.40%	0.20%	
Fargo North End	442.93	---	893.80		0.55%	0.80%	7.69%	18.12%	32.96%	99.97%	99.25%	94.16%	74.19%	31.51%	10.79%
Ridgewood	447.78	898	898.00		0.23%	0.29%	2.89%	7.08%	13.66%	100.00%	100.00%	99.82%	96.55%	72.35%	41.48%
Near North	449.61	---	897.30		0.35%	0.46%	4.47%	10.80%	20.44%	100.00%	99.99%	99.27%	90.97%	53.57%	23.33%
Downtown North	451.37	---	898.10		0.35%	0.46%	4.48%	10.82%	20.46%	100.00%	100.00%	99.30%	91.13%	53.46%	23.06%
Downtown South	452.25	902.2	902.20		0.19%	0.24%	2.39%	5.87%	11.39%	1.00%	100.00%	99.92%	97.91%	78.55%	48.88%
Near South	452.7	904	904.00		0.33%	0.40%	3.97%	9.64%	18.34%	99.50%	99.46%	99.08%	95.83%	77.25%	51.50%
Lindenwood Area	454.1	---	902.07		0.23%	0.29%	2.86%	7.00%	13.52%	100.00%	100.00%	99.85%	96.84%	72.66%	41.00%
Z_Other	650	---	900.61		0.27%	0.35%	3.45%	8.41%	16.11%	100.00%	100.00%	99.73%	95.27%	65.72%	33.47%
Fargo South															
From RRN	460.28	---	903.08		0.30%	0.39%	3.83%	9.29%	17.73%	99.99%	100.00%	99.61%	93.95%	61.00%	28.93%
From Sheyenne	172308	---	904.54		9.96%	11.04%	68.94%	94.62%	99.71%	50.68%	0.00%	0.00%	0.00%	0.00%	0.00%
West Fargo															
WF Downtown	451.37	---	902.00		0.16%	0.19%	1.87%	4.60%	9.00%	100.00%	100.00%	99.96%	98.77%	84.55%	58.20%
WF South	172308	---	904.44		11.65%	12.55%	73.83%	96.50%	99.88%	35.29%	0.00%	0.00%	0.00%	0.00%	0.00%
Harwood															
Harwood Red	432.84	---	887.92		7.72%	9.82%	64.44%	92.46%	99.43%	59.55%	14.86%	3.31%	0.65%	0.08%	0.02%
Harwood Sheyenne	67984	---	887.30		17.86%	17.91%	86.11%	99.28%	99.99%	4.79%	0.00%	0.00%	0.00%	0.00%	0.00%
Cass County															
ANorth (RRN)	440.31	---	890.21		5.57%	7.44%	53.86%	85.54%	97.91%	74.82%	33.72%	13.45%	4.29%	0.60%	0.09%
ASouth (RRN)	465.1	---	899.64		0.77%	1.13%	10.72%	24.68%	43.27%	99.26%	98.76%	91.74%	62.01%	16.83%	3.69%
BNorth (RRN)	440.31	---	886.75		25.47%	25.99%	95.07%	99.95%	100.00%	0.03%	0.00%	0.00%	0.00%	0.00%	0.00%
BSouth (RRN)	465.1	---	901.11		15.23%	15.96%	82.42%	98.71%	99.98%	9.42%	0.02%	0.00%	0.00%	0.00%	0.00%
ASheyenne	172308	---	902.25		47.93%	47.73%	99.85%	100.00%	100.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
ShySA	166	---	890.01		5.40%	5.97%	45.96%	78.53%	95.39%	88.82%	26.66%	1.02%	0.00%	0.00%	0.00%
Moorhead															
Kragnes	434.61	---	889.57		3.56%	4.75%	38.53%	70.37%	91.22%	91.05%	53.35%	25.11%	9.78%	2.16%	0.53%
Oakport	440.31	900.5	900.50		0.04%	0.04%	0.39%	0.98%	1.95%	100.00%	100.00%	100.00%	99.95%	98.32%	91.40%
North of Moorhead	442.93	---	892.83		0.83%	1.42%	13.31%	30.03%	51.05%	99.53%	94.57%	80.02%	51.86%	16.15%	4.41%
Moorhead North	449.61	---	898.17		0.28%	0.37%	3.66%	8.91%	17.02%	100.00%	100.00%	99.64%	94.27%	62.92%	31.23%
Moorhead Central	452.7	---	900.67		0.27%	0.35%	3.42%	8.33%	15.97%	100.00%	100.00%	99.74%	95.38%	66.14%	33.89%
Moorhead South	460.28	---	902.22		0.35%	0.45%	4.36%	10.56%	20.00%	99.99%	100.00%	99.41%	91.79%	54.47%	23.45%
South of Moorhead	468.9	---	905.54		9.35%	9.84%	64.49%	92.49%	99.44%	55.64%	2.59%	0.07%	0.00%	0.00%	0.00%
Downstream															
Georgetown MN&ND - XS 414.98	414.98	---	879.06		13.59%	14.13%	78.21%	97.78%	99.95%	13.08%	0.23%	0.00%	0.00%	0.00%	0.00%
Halstad MN&ND - XS 397.8	397.80	---	872.91		10.12%	10.23%	66.02%	93.27%	99.55%	48.25%	2.34%	0.00%	0.00%	0.00%	0.00%
Perley-Hendrum MN&ND - XS 381.71	381.71	---	867.25		8.73%	8.97%	60.94%	90.47%	99.09%	58.41%	11.72%	1.78%	0.29%	0.00%	0.00%
Shelly MN&ND - XS 359.73	359.73	---	860.15		5.14%	5.53%	43.37%	75.86%	94.17%	93.27%	31.57%	6.52%	1.24%	0.28%	0.00%
Climax MN&ND - XS 335.01	335.01	---	849.35		5.97%	6.27%	47.66%	80.18%	96.07%	89.24%	22.75%	4.08%	0.51%	0.00%	0.00%
South of Thompson - XS 324.41	324.41	---	846.59		4.32%	4.65%	37.85%	69.55%	90.73%	97.56%	44.29%	11.22%	2.03%	0.44%	0.17%
Intermediate - XS 423.96	423.96	---	882.00		15.40%	15.92%	82.34%	98.69%	99.98%	2.32%	0.00%	0.00%	0.00%	0.00%	0.00%
Upstream															
Upstream_Red	500.01	---	920.28		3.76%	4.05%	33.83%	64.38%	87.31%	98.78%	53.88%	17.08%	7.58%	1.10%	0.28%
Upstream_WR	32.12	---	924.42		8.10%	8.32%	58.04%	88.60%	98.70%	64.63%	11.74%	1.39%	0.00%	0.00%	0.00%

Project Performance by Reach (Target Stages - Annual Exceedance Probabilities - Long-Term Risk - Conditional Non-Exceedance Probabilities)

Net Change - ND w/Staging - LPP

				Target Stage Annual Exceedance Probability		Long-Term Risk (years)			Conditional Non-Exceedance Probability by Events						
Reach	Index River Mile	Top of Levee	Target Stage	Median	Expected	10	30	50	10%	4%	2%	1%	0.40%	0.20%	
Fargo North End	442.93	---	893.80		8.58%	8.89%	57.55%	78.75%	75.21%	40.68%	94.47%	98.31%	86.70%	44.55%	17.08%
Ridgewood	447.78	898	898.00		3.19%	3.69%	30.49%	56.70%	73.23%	1.61%	42.40%	82.24%	93.26%	72.27%	41.28%
Near North	449.61	---	897.30		6.01%	6.60%	47.54%	73.70%	78.21%	16.14%	84.28%	97.94%	92.50%	56.99%	25.64%
Downtown North	451.37	---	898.10		6.23%	6.81%	48.60%	74.49%	78.25%	17.47%	86.68%	98.37%	92.30%	56.18%	24.89%
Downtown South	452.25	902.2	902.20		2.55%	2.92%	25.04%	49.20%	68.22%	0.23%	26.24%	73.25%	92.59%	77.08%	47.08%
Near South	452.7	904	904.00		3.01%	3.27%	27.27%	51.30%	66.77%	7.10%	26.34%	55.67%	79.80%	74.74%	50.34%
Lindenwood Area	454.1	---	902.07		3.42%	3.83%	31.45%	57.92%	73.92%	1.13%	46.13%	87.59%	95.32%	71.69%	39.78%
Z_Other	650	---	900.61		4.42%	4.85%	37.91%	65.30%	77.07%	3.90%	65.26%	94.54%	94.97%	65.73%	33.27%
Fargo South															
From RRN	460.28	---	903.08		5.44%	5.90%	43.93%	70.84%	78.00%	9.56%	79.85%	97.57%	93.57%	59.85%	27.83%
From Sheyenne	172308	---	904.54		9.95%	11.03%	68.86%	94.38%	99.21%	49.34%	99.97%	99.97%	99.97%	99.95%	99.95%
West Fargo															
WF Downtown	451.37	---	902.00		1.87%	2.08%	18.65%	39.02%	59.05%	0.04%	11.67%	49.75%	81.21%	81.15%	56.26%
WF South	172308	---	904.44		11.64%	12.53%	73.72%	96.24%	99.38%	64.64%	99.97%	99.97%	99.97%	99.95%	99.95%
Harwood															
Harwood Red	432.84	---	887.92		11.79%	11.49%	57.79%	56.50%	34.87%	74.44%	86.47%	67.88%	39.64%	10.76%	2.68%
Harwood Sheyenne	67984	---	887.30		16.27%	16.17%	70.05%	63.85%	41.69%	95.17%	98.53%	87.54%	0.00%	0.00%	0.00%
Cass County															
ANorth (RRN)	440.31	---	890.21		15.43%	15.16%	67.76%	62.44%	40.19%	91.27%	91.60%	75.84%	44.24%	10.60%	2.18%
ASouth (RRN)	465.1	---	899.64		19.30%	18.96%	78.88%	75.50%	57.56%	97.55%	98.95%	92.44%	63.41%	17.70%	3.97%
BNorth (RRN)	440.31	---	886.75		5.19%	5.40%	5.03%	0.26%	0.00%	0.12%	0.00%	0.00%	0.00%	0.00%	0.00%
BSouth (RRN)	465.1	---	901.11		14.64%	15.20%	75.11%	81.41%	68.38%	90.55%	99.88%	96.64%	75.43%	27.82%	7.77%
ASheyenne	172308	---	902.25		16.60%	16.25%	2.13%	0.01%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
ShySA	166	---	890.01		3.87%	4.26%	30.10%	43.47%	37.56%	11.13%	70.92%	88.17%	0.00%	0.00%	0.00%
Moorhead															
Kragnes	434.61	---	889.57		10.19%	10.21%	60.48%	74.25%	62.91%	57.40%	95.62%	91.87%	68.95%	26.24%	8.24%
Oakport	440.31	900.5	900.50		0.19%	0.30%	2.94%	7.14%	13.63%	0.00%	0.01%	0.65%	6.12%	29.92%	49.45%
North of Moorhead	442.93	---	892.83		10.78%	11.12%	64.84%	79.70%	70.39%	64.53%	98.70%	97.11%	78.83%	32.83%	10.51%
Moorhead North	449.61	---	898.17		4.70%	5.12%	39.57%	66.97%	77.55%	6.05%	67.92%	94.44%	94.43%	64.33%	32.12%
Moorhead Central	452.7	---	900.67		4.35%	4.78%	37.52%	64.91%	76.99%	3.64%	64.15%	94.24%	95.02%	66.04%	33.60%
Moorhead South	460.28	---	902.22		6.71%	7.26%	50.75%	75.85%	77.93%	21.16%	90.58%	98.87%	91.59%	53.85%	22.88%
South of Moorhead	468.9	---	905.54		8.94%	9.31%	59.37%	80.16%	76.29%	44.34%	97.40%	98.97%	88.34%	46.31%	17.42%
Downstream															
Georgetown MN&ND - XS 414.98	414.98	---	879.06		1.29%	1.10%	3.19%	1.02%	0.07%	11.83%	1.16%	0.00%	0.00%	0.00%	0.00%
Halstad MN&ND - XS 397.8	397.80	---	872.91		1.33%	1.38%	6.13%	3.98%	0.85%	16.78%	2.26%	0.03%	0.00%	0.00%	0.00%
Perley-Hendrum MN&ND - XS 381.71	381.71	---	867.25		0.30%	0.22%	1.00%	0.70%	0.17%	3.51%	-0.59%	-1.10%	-0.44%	-0.07%	0.00%
Shelly MN&ND - XS 359.73	359.73	---	860.15		-0.06%	-0.06%	-0.39%	-0.45%	-0.25%	-0.21%	-0.96%	-0.62%	0.05%	0.02%	0.00%
Climax MN&ND - XS 335.01	335.01	---	849.35		-0.11%	-0.10%	-0.58%	-0.59%	-0.27%	-0.45%	-1.39%	-0.51%	0.07%	0.14%	0.00%
South of Thompson - XS 324.41	324.41	---	846.59		-0.12%	-0.11%	-0.76%	-1.00%	-0.69%	-0.16%	-2.25%	-1.32%	0.17%	0.06%	0.01%
Intermediate - XS 423.96	423.96	---	882.00		8.61%	9.00%	33.78%	18.98%	4.23%	85.26%	20.21%	2.29%	0.41%	0.00%	0.00%
Upstream															
Upstream_Red	500.01	---	920.28		-3.15%	-3.25%	-19.33%	-20.75%	-10.62%	-30.38%	-27.40%	-7.16%	-3.61%	-0.28%	-0.04%
Upstream_WR	32.12	---	924.42		-0.04%	0.00%	0.00%	0.00%	0.00%	0.21%	-0.28%	-0.11%	0.00%	0.00%	0.00%

Project Performance by Reach (Target Stages - Annual Exceedance Probabilities - Long-Term Risk - Conditional Non-Exceedance Probabilities)

Net Change - ND35k															
				Target Stage Annual Exceedance Probability		Long-Term Risk (years)			Conditional Non-Exceedance Probability by Events						
Reach	Index River Mile	Top of Levee	Target Stage	Median	Expected	10	30	50	10%	4%	2%	1%	0.40%	0.20%	
Fargo North End	442.93	---	893.80		8.58%	8.89%	57.55%	78.75%	75.21%	40.68%	94.47%	98.31%	86.70%	44.55%	17.08%
Ridgewood	447.78	898	898.00		3.19%	3.69%	30.49%	56.70%	73.23%	1.61%	42.40%	82.24%	93.26%	72.27%	41.28%
Near North	449.61	---	897.30		6.01%	6.60%	47.54%	73.70%	78.21%	16.14%	84.28%	97.94%	92.50%	56.99%	25.64%
Downtown North	451.37	---	898.10		6.23%	6.81%	48.60%	74.49%	78.25%	17.47%	86.68%	98.37%	92.30%	56.18%	24.89%
Downtown South	452.25	902.2	902.20		2.55%	2.92%	25.04%	49.20%	68.22%	0.23%	26.24%	73.25%	92.59%	77.08%	47.08%
Near South	452.7	904	904.00		3.01%	3.27%	27.27%	51.30%	66.77%	7.10%	26.34%	55.67%	79.80%	74.74%	50.34%
Lindenwood Area	454.1	---	902.07		3.42%	3.83%	31.45%	57.92%	73.92%	1.13%	46.13%	87.59%	95.32%	71.69%	39.78%
Z_Other	650	---	900.61		4.42%	4.85%	37.91%	65.30%	77.07%	3.90%	65.26%	94.54%	94.97%	65.73%	33.27%
Fargo South															
From RRN	460.28	---	903.08		5.44%	5.90%	43.93%	70.84%	78.00%	9.56%	79.85%	97.57%	93.57%	59.85%	27.83%
From Sheyenne	172308	---	904.54		9.95%	11.03%	68.86%	94.38%	99.21%	49.34%	99.97%	99.97%	99.97%	99.95%	99.95%
West Fargo															
WF Downtown	451.37	---	902.00		1.87%	2.08%	18.65%	39.02%	59.05%	0.04%	11.67%	49.75%	81.21%	81.15%	56.26%
WF South	172308	---	904.44		11.64%	12.53%	73.72%	96.24%	99.38%	64.64%	99.97%	99.97%	99.97%	99.95%	99.95%
Harwood															
Harwood Red	432.84	---	887.92		11.79%	11.49%	57.79%	56.50%	34.87%	74.44%	86.47%	67.88%	39.64%	10.76%	2.68%
Harwood Sheyenne	67984	---	887.30		16.27%	16.17%	70.05%	63.85%	41.69%	95.17%	98.53%	87.54%	0.00%	0.00%	0.00%
Cass County															
ANorth (RRN)	440.31	---	890.21		15.43%	15.16%	67.76%	62.44%	40.19%	91.27%	91.60%	75.84%	44.24%	10.60%	2.18%
ASouth (RRN)	465.1	---	899.64		19.30%	18.96%	78.88%	75.50%	57.56%	97.55%	98.95%	92.44%	63.41%	17.70%	3.97%
BNorth (RRN)	440.31	---	886.75		5.19%	5.40%	5.03%	0.26%	0.00%	0.12%	0.00%	0.00%	0.00%	0.00%	0.00%
BSouth (RRN)	465.1	---	901.11		14.64%	15.20%	75.11%	81.41%	68.38%	90.55%	99.88%	96.64%	75.43%	27.82%	7.77%
ASheyenne	172308	---	902.25		16.60%	16.25%	2.13%	0.01%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
ShySA	166	---	890.01		3.87%	4.26%	30.10%	43.47%	37.56%	11.13%	70.92%	88.17%	0.00%	0.00%	0.00%
Moorhead															
Kragnes	434.61	---	889.57		10.19%	10.21%	60.48%	74.25%	62.91%	57.40%	95.62%	91.87%	68.95%	26.24%	8.24%
Oakport	440.31	900.5	900.50		0.19%	0.30%	2.94%	7.14%	13.63%	0.00%	0.01%	0.65%	6.12%	29.92%	49.45%
North of Moorhead	442.93	---	892.83		10.78%	11.12%	64.84%	79.70%	70.39%	64.53%	98.70%	97.11%	78.83%	32.83%	10.51%
Moorhead North	449.61	---	898.17		4.70%	5.12%	39.57%	66.97%	77.55%	6.05%	67.92%	94.44%	94.43%	64.33%	32.12%
Moorhead Central	452.7	---	900.67		4.35%	4.78%	37.52%	64.91%	76.99%	3.64%	64.15%	94.24%	95.02%	66.04%	33.60%
Moorhead South	460.28	---	902.22		6.71%	7.26%	50.75%	75.85%	77.93%	21.16%	90.58%	98.87%	91.59%	53.85%	22.88%
South of Moorhead	468.9	---	905.54		8.94%	9.31%	59.37%	80.16%	76.29%	44.34%	97.40%	98.97%	88.34%	46.31%	17.42%
Downstream															
Georgetown MN&ND - XS 414.98	414.98	---	879.06		-0.71%	-0.77%	-2.03%	-0.55%	-0.03%	-11.48%	-2.25%	-0.22%	0.00%	0.00%	0.00%
Halstad MN&ND - XS 397.8	397.80	---	872.91		-1.31%	-0.92%	-3.64%	-1.95%	-0.30%	-11.29%	-3.74%	-0.24%	0.00%	0.00%	0.00%
Perley-Hendrum MN&ND - XS 381.71	381.71	---	867.25		-1.04%	-0.73%	-3.25%	-2.11%	-0.45%	-5.93%	-7.88%	-3.60%	-1.33%	-0.28%	0.00%
Shelly MN&ND - XS 359.73	359.73	---	860.15		-0.61%	-0.62%	-3.82%	-4.28%	-2.25%	-2.95%	-8.84%	-3.21%	-0.77%	-0.06%	0.00%
Climax MN&ND - XS 335.01	335.01	---	849.35		-0.57%	-0.54%	-3.11%	-3.07%	-1.31%	-3.38%	-6.09%	-1.87%	-0.31%	0.00%	0.00%
South of Thompson - XS 324.41	324.41	---	846.59		-0.52%	-0.52%	-3.46%	-4.42%	-2.88%	-1.09%	-9.21%	-4.77%	-1.28%	-0.13%	-0.01%
Intermediate - XS 423.96	423.96	---	882.00		-0.75%	-0.80%	-1.75%	-0.35%	-0.01%	-9.64%	-0.65%	0.00%	0.00%	0.00%	0.00%
Upstream															
Upstream_Red	500.01	---	920.28		-0.03%	-0.04%	-0.26%	-0.35%	-0.25%	-0.15%	-0.63%	-0.32%	0.05%	0.01%	0.00%
Upstream_WR	32.12	---	924.42		-0.60%	-0.42%	-1.95%	-1.37%	-0.33%	-5.86%	-1.43%	0.06%	0.00%	0.00%	0.00%

Project Performance by Reach (Target Stages - Annual Exceedance Probabilities - Long-Term Risk - Conditional Non-Exceedance Probabilities)
Net Change - MN35k - FCP

				Target Stage Annual Exceedance Probability		Long-Term Risk (years)			Conditional Non-Exceedance Probability by Events						
Reach	Index River Mile	Top of Levee	Target Stage	Median	Expected	10	30	50	10%	4%	2%	1%	0.40%	0.20%	
Fargo North End	442.93	---	893.80		8.46%	8.65%	55.23%	73.50%	66.34%	40.65%	93.74%	93.77%	74.17%	31.51%	10.79%
Ridgewood	447.78	898	898.00		3.20%	3.69%	30.49%	56.70%	73.22%	1.62%	42.40%	82.23%	93.10%	72.08%	41.44%
Near North	449.61	---	897.30		5.99%	6.57%	47.24%	72.99%	76.94%	16.14%	84.28%	97.73%	90.89%	53.57%	23.33%
Downtown North	451.37	---	898.10		6.21%	6.78%	48.35%	73.90%	77.20%	17.48%	86.68%	98.21%	91.08%	53.46%	23.06%
Downtown South	452.25	902.2	902.20		2.56%	2.93%	25.13%	49.40%	68.60%	-98.76%	26.24%	73.26%	92.75%	78.25%	48.86%
Near South	452.7	904	904.00		3.00%	3.25%	27.11%	50.94%	66.11%	7.08%	26.29%	55.49%	79.34%	74.81%	51.13%
Lindenwood Area	454.1	---	902.07		3.42%	3.84%	31.54%	58.15%	74.34%	1.14%	46.13%	87.60%	95.47%	72.63%	41.00%
Z_Other	650	---	900.61		4.42%	4.84%	37.88%	65.23%	76.94%	3.91%	65.26%	94.53%	94.90%	65.71%	33.47%
Fargo South															
From RRN	460.28	---	903.08		5.45%	5.92%	44.03%	71.07%	78.42%	9.57%	79.85%	97.60%	93.86%	61.00%	28.93%
From Sheyenne	172308	---	904.54		0.00%	0.01%	0.02%	0.01%	0.00%	0.07%	0.00%	0.00%	0.00%	0.00%	0.00%
West Fargo															
WF Downtown	451.37	---	902.00		1.88%	2.09%	18.74%	39.23%	59.45%	0.05%	11.67%	49.75%	81.34%	82.13%	57.85%
WF South	172308	---	904.44		0.00%	0.00%	-0.01%	0.00%	0.00%	-0.02%	0.00%	0.00%	0.00%	0.00%	0.00%
Harwood															
Harwood Red	432.84	---	887.92		5.11%	3.75%	12.31%	4.93%	0.50%	35.94%	14.19%	3.29%	0.65%	0.08%	0.02%
Harwood Sheyenne	67984	---	887.30		0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Cass County															
ANorth (RRN)	440.31	---	890.21		10.78%	9.53%	30.56%	13.50%	2.08%	67.98%	33.70%	13.45%	4.29%	0.60%	0.09%
ASouth (RRN)	465.1	---	899.64		19.28%	18.93%	78.62%	74.95%	56.73%	97.56%	98.76%	91.74%	62.01%	16.83%	3.69%
BNorth (RRN)	440.31	---	886.75		0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
BSouth (RRN)	465.1	---	901.11		0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
ASheyenne	172308	---	902.25		0.01%	0.01%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
ShySA	166	---	890.01		0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Moorhead															
Kragnes	434.61	---	889.57		7.25%	6.38%	30.72%	24.39%	8.50%	48.56%	50.24%	24.85%	9.76%	2.16%	0.53%
Oakport	440.31	900.5	900.50		0.19%	0.30%	2.94%	7.14%	13.63%	0.00%	0.01%	0.65%	6.12%	29.94%	49.46%
North of Moorhead	442.93	---	892.83		10.48%	10.40%	58.26%	65.66%	48.77%	64.07%	93.37%	79.98%	51.86%	16.15%	4.41%
Moorhead North	449.61	---	898.17		4.69%	5.11%	39.45%	66.68%	77.02%	6.06%	67.92%	94.38%	93.80%	62.91%	31.23%
Moorhead Central	452.7	---	900.67		4.35%	4.78%	37.48%	64.82%	76.82%	3.64%	64.15%	94.23%	94.98%	66.14%	33.89%
Moorhead South	460.28	---	902.22		6.71%	7.27%	50.81%	75.99%	78.19%	21.17%	90.58%	98.88%	91.77%	54.47%	23.45%
South of Moorhead	468.9	---	905.54		0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.00%	0.00%	0.00%	0.00%	0.00%
Downstream															
Georgetown MN&ND - XS 414.98	414.98	---	879.06		-0.71%	-0.77%	-2.03%	-0.55%	-0.03%	-11.48%	-2.25%	-0.22%	0.00%	0.00%	0.00%
Halstad MN&ND - XS 397.8	397.80	---	872.91		-1.31%	-0.92%	-3.64%	-1.95%	-0.30%	-11.29%	-3.74%	-0.24%	0.00%	0.00%	0.00%
Perley-Hendrum MN&ND - XS 381.71	381.71	---	867.25		-1.04%	-0.73%	-3.25%	-2.11%	-0.45%	-5.93%	-7.88%	-3.60%	-1.33%	-0.28%	0.00%
Shelly MN&ND - XS 359.73	359.73	---	860.15		-0.61%	-0.62%	-3.82%	-4.28%	-2.25%	-2.95%	-8.84%	-3.21%	-0.77%	-0.06%	0.00%
Climax MN&ND - XS 335.01	335.01	---	849.35		-0.57%	-0.54%	-3.11%	-3.07%	-1.31%	-3.38%	-6.09%	-1.87%	-0.31%	0.00%	0.00%
South of Thompson - XS 324.41	324.41	---	846.59		-0.52%	-0.52%	-3.46%	-4.42%	-2.88%	-1.09%	-9.21%	-4.77%	-1.28%	-0.13%	-0.01%
Intermediate - XS 423.96	423.96	---	882.00		-0.75%	-0.80%	-1.75%	-0.35%	-0.01%	-9.64%	-0.65%	0.00%	0.00%	0.00%	0.00%
Upstream															
Upstream_Red	500.01	---	920.28		-0.03%	-0.04%	-0.26%	-0.35%	-0.25%	-0.15%	-0.63%	-0.32%	0.05%	0.01%	0.00%
Upstream_WR	32.12	---	924.42		-0.60%	-0.42%	-1.95%	-1.37%	-0.33%	-5.86%	-1.43%	0.06%	0.00%	0.00%	0.00%

EXHIBIT N
Calculation of Flood Proof Cost Savings

Table xx - Calculation of Floodproofing Cost Savings

Annual land demanded for growth (2018 - 2068)	266						
Number of years	<u>50</u>						
Total land demanded for growth (2018 - 2068)	13,300						
	<u>Tier 1</u>	<u>Tier 2</u>	<u>Fargo</u>	<u>Total</u>	<u>Acres benefited per year</u>	<u>Savings per acre</u>	<u>Savings per year</u>
Area available for future growth	6300	11800	1600	19700			
Growth areas in 100-year flood plain	5100	7800	800	13700			
100-yr land opened by ND 35k and 30k plans	5000	6900	800	12700			
Land benefitted	5000	5400	800	11200	224	\$ 46,550	\$ 10,427,200
Land outside of 100-yr floodplain	1200		800	2000			
Land req floodproofing	<u>100</u>			<u>100</u>			
	6300	5400	1600	13300			
100-yr land opened by MN Short 35k and 30k plans	4600	1600	500	6700			
Land benefitted	4600	1600	500	6700	134	46,550	6,237,700
Land outside of 100-yr floodplain	1200		800	2000			
Land req floodproofing	<u>500</u>	<u>3800</u>	<u>300</u>	<u>4600</u>			
	6300	5400	1600	13300			
100-yr land opened by MN Short 25k plan	4600	1600	500	6700			
Land benefitted	4600	1600	500	6700	134	46,550	6,237,700
Land outside of 100-yr floodplain	1200		800	2000			
Land req floodproofing	<u>500</u>	<u>3800</u>	<u>300</u>	<u>4600</u>			
	6300	5400	1600	13300			
100-yr land opened by MN Short 20k plan	4300	1600	500	6400			
Land benefitted	4300	1600	500	6400	128	46,550	5,958,400
Land outside of 100-yr floodplain	1200		800	2000			
Land req floodproofing	<u>800</u>	<u>3800</u>	<u>300</u>	<u>4900</u>			
	6300	5400	1600	13300			
100-yr land opened by MN Short 15k plan	3700	1600	500	5800			
Land benefitted	3700	1600	500	5800	116	46,550	5,399,800
Land outside of 100-yr floodplain	1200		800	2000			
Land req floodproofing	<u>1400</u>	<u>3800</u>	<u>300</u>	<u>5500</u>			
	6300	5400	1600	13300			

ATTACHMENT 1

**Fargo-Moorhead Nonresidential and Residential Structure Inventory and
Surveys**

Final Project Report Fargo-Moorhead Nonresidential and Residential Structure Inventory and Nonresidential Surveys

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Prepared For:

U.S. Army Corps of Engineers
St. Paul District



December 2009

Final Project Report Fargo-Moorhead Nonresidential and Residential Structure Inventory and Nonresidential Surveys

December 2009

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RED RIVER OF THE NORTH FEASIBILITY STUDY BASELINE ECONOMIC ANALYSIS REPORT

RESIDENTIAL INVENTORY ANALYSIS & NONRESIDENTIAL FLOOD DAMAGE SURVEY

December 2009

1.0 INTRODUCTION

The U.S. Army Corps of Engineers (USACE), St. Paul District, is conducting the Fargo-Moorhead Feasibility Study. As part of that baseline economic analysis, URS Group, Inc. (URS) conducted the field collection and analysis of selected structures, which consisted of the following tasks:

1. Through site reconnaissance, collect structure details for all nonresidential structures and a random sample of residential structures within the study area.
2. Estimate the depreciated structure value for each structure inventoried in the field using the Marshall & Swift (M&S) estimating software.
3. Calculate an adjustment factor based on the difference between the tax assessment value and the M&S depreciated structure value for the residential structures inventoried.
4. Develop and facilitate Office of Management and Budget (OMB) approval of a survey instrument to estimate potential flood damages at nonresidential structures.
5. Collect flood damage information through onsite interviews for selected nonresidential structures.

The study area consisted of the 500-year floodplain along the Red River of the North and several tributaries within the Fargo-Moorhead metropolitan area. Therefore the study area covers both sides of the river and parts of both North Dakota and Minnesota.

Data collected from the structure inventory and nonresidential surveys are to be incorporated into the overall economic analysis. The methodology and a summary of the collected data are contained in this report.

2.0 STRUCTURE INVENTORY

The purpose of the structure inventory was to collect data on selected residential and all nonresidential structures in the Red River of the North watershed. All information collected in the field was recorded in a field data collection tool and entered into the M&S software once field work was completed.

URS identified the structures to be inventoried from three tax databases. The tax assessor data were obtained from the City of Fargo, ND, as well as Clay County, MN and Cass County, ND. The tax data were compiled and formatted in order to be consistent with field software input requirements. URS delineated the study area using FEMA's floodplain map for the 0.2-percent-annual-chance event (500-year floodplain) provided by the St Paul District.

An inventory of all residential structures in the study area was not completed for this effort due to the size of the Red River watershed and the number of residential structures within the floodplain. Instead, a random sample of residential structures was selected to be inventoried. Over 3,200 residential structures were inventoried. The inventoried structures were used to create adjustment factors to apply to the remaining structures in the study area. Further details on the steps taken to calculate these factors are provided later in this section.

2.1 Field Database

The field database was constructed using tax databases from the City of Fargo, Clay County, and Cass County. The three databases were combined and overlain on the delineated floodplain map. Any structures outside of this map were removed from the field database and considered outside of the study area.

There are two primary ways to break down the tax information, by tax parcel or by building footprint. How the information is being used typically dictates which way the information is dissected. Sometimes reporting information by tax parcel is sufficient. However, structure inventories collect information by individual structures, not by parcel to ensure flood damages and benefits are calculated correctly. There are several instances in the study area where multiple structures exist on one parcel, so the building footprints were used to populate the field database instead of the tax parcels. This made field collection easier by having more structures identified in the database prior to fieldwork starting. This provided a more accurate count of structures to allowing better estimates of the required field efforts.

Using building footprints provided the extra benefit of excluding tax parcels with no structures. However, the field crews drove the entire area in case newer buildings had been constructed or the footprint file was not completely accurate. In addition, large buildings that cover multiple tax parcels were reduced to one entry. These buildings are larger industrial buildings or shopping complexes.

The study area was divided into several smaller survey areas using roads as boundaries. These survey areas allowed multiple teams to work simultaneously without duplicating efforts. Each

team inventoried their assigned area until it was completed and then moved on to a newly assigned area.

2.2 Data Collection

Four two-person teams performed the data collection. Each team was equipped with a laptop computer and a digital camera. All structure information was collected from outside the structure and recorded in the database. A letter of introduction containing a project description and contact information was available to provide to property owners upon request.

The characteristics collected for each structure were based on fields used in the M&S Residential and Commercial Estimator Programs to calculate depreciated replacement value and new replacement value.

The following information was collected for each residential structure:

- Address
- Photograph of structure
- Latitude and Longitude
- Characteristics
 - Type of structure (e.g., single family)
 - Type of foundation
 - Finished floor area
 - Effective age
 - Quality of construction
 - Condition of structure
 - Style of structure (e.g., one story)
 - Type of exterior wall (e.g., siding)
 - Type of roofing
 - Presence of garage
 - Presence of other outbuildings
 - Presence of fireplaces
 - Height of the first floor in relation to the adjacent grade
 - Presence of basement

URS estimated the finished floor area of each structure utilizing an aerial photograph and tracing tool available on each computer. The effective age of each structure was estimated using a combination of factors: the style in which the structure was built, the appearance, and any improvements done to the original structure. The effective age takes into account renovations to

a structure since the original construction. The construction quality of the building was determined by looking at the workmanship in relation to the materials used. The appearance and condition of the structure in relation to the effective age determined the physical condition of the buildings.

The following information was collected for each nonresidential structure:

- Name of business
- Address
- Photograph of structure
- Latitude and Longitude
- Characteristics
 - General use of structure (occupancy code)
 - Effective age
 - Total floor area
 - Construction class (e.g., masonry bearing walls)
 - Story height
 - Quality of construction
 - Number of stories
 - Perimeter shape
 - Height of the first floor in relation to the adjacent grade

The survey teams used aerial maps to locate the selected residential or nonresidential structures. Structures that no longer exist were deleted from the database. Additional unmarked nonresidential structures that are clearly within the study area were added to the database. Some database entries were deleted in the field due to incorrect identifications as structures (e.g., a dumpster was marked as a structure) or because the structure had recently been demolished. Occasionally, structures were inaccessible and attributes could not be collected. This occurred when structures were located in high security areas or inside compounds the field crews could not gain access to (e.g., National Guard installation or parts of the airport).

To more accurately estimate the depreciated replacement value, the surveyors assigned an M&S 3-digit occupancy code to each structure based on its use (Table 1). Use is determined by the activities conducted in the building as observed during the field survey and by company name. The predominant use of, or activity performed in, a structure determines both the type of construction and quality of materials used. For example, the construction design and the materials used for a fast food restaurant can be very different than those used for a warehouse or a small office.

Table 1: List of 3-Digit Occupancy Codes Used

OCCID	Definition	OCCID	Definition
127	Winery Shop	421	Storage, Grain
133	Storage Shed, Prefabricated	423	Mini-Lube Garage
135	Hoop Greenhouse, Arch-Rib, Small (under 4,500 square feet)	426	Day Care Center
138	Hoop Greenhouse, Arch-Rib, Large (over 9,000 square feet)	427	Fire Station (Volunteer)
139	Straight Wall Greenhouse, Large (over 9,000 square feet)	428	Horse Arena
140	Modified Hoop Greenhouse, Medium (4,500 - 9,000 square feet)	431	Outpatient (Surgical) Center
141	Hoop Greenhouse, Arch-Rib, Medium (4,500 - 9,000 square feet)	432	Restroom Building
157	Storage, Maintenance Building	434	Self-Serve Car Wash
158	Special Education Classrooms	435	Drive-Thru Car Wash
170	Institutional Greenhouse, Small (under 4,500 square feet)	436	Car Wash, Automatic
171	Institutional Greenhouse, Medium (4,500 - 9,000 square feet)	442	Tavern/Bar
172	Institutional Greenhouse, Large (over 9,000 square feet)	443	Central Bank
173	Educational Wing, Church	444	Office, Dental
174	Pavilion	446	Supermarket
175	Skating Rink, Ice	447	Storage Facility, Cold
176	Skating Rink, Roller	451	Multiple Residence, Senior Citizen (Low Rise)
181	Storage Shed, Prefabricated, Secure	454	Shell, Industrial Building
183	Starter Booth, Golf	455	Auto Dealership, Complete
184	Shelter, Arena	456	Tool Shed
185	Truck Wash	458	Warehouse Discount Store
300	Apartment (High Rise)	459	Shopping Center, Mixed with Residential Units
301	Armory	468	Shed, Material Storage
302	Auditorium	470	Storage, Equipment Shop
303	Showroom, Automobile	471	Utility Building, Light Commercial
304	Bank	472	Shed, Equipment
305	Barn	473	Shelter, Material
306	Bowling Center	476	Storage, Farm Implement
308	Church with Sunday School	477	Utility Building, Farm
309	Church	478	Shed, Farm Implement
311	Clubhouse	479	Shed, Farm Utility Storage
313	Hospital, Convalescent	481	Museum
314	Country Club	482	Convention Center
316	Dairy	483	Fitness Center
318	Store, Department	484	High School (Entire)
319	Store, Discount	485	Natatorium
321	Dormitory	486	Field House
322	Fire Station (Staffed)	487	Vocational School
323	Fraternal Building	488	Bookstore (School)
324	Fraternity House	490	Kennel
326	Storage Garage	491	Government Community Service Building

OCCID	Definition	OCCID	Definition
327	Governmental Building	492	Shell, Office Building
328	Storage Hangar	493	Storage, Flathouse
329	Hangar, Maintenance and Office	494	Industrial Light Manufacturing
330	Home For The Elderly	495	Industrial Heavy Manufacturing
331	Hospital	496	Laboratory
335	Jail, Correctional Facility	498	Broadcast Facility
336	Laundromat	499	Laundry/Dry Cleaners
337	Library, Public	508	Car Wash Canopy
339	Storage, Lumber Shed, Horizontal	514	Community Center
340	Market	515	Casino
341	Office, Medical	518	Lath Shade House (Greenhouse)
342	Mortuary	519	Shade Shelter (Greenhouse)
343	Motel	523	Storage, Golf Cart Building
344	Office Building	526	Shed, Service Garage
345	Parking Structure	527	Municipal Service Garage
348	Rectory	528	Service Repair Garage
349	Restaurant, Fast Food	529	Snack Bar
350	Restaurant, Table Service	530	Restaurant, Cafeteria
352	Multiple Residence (Low Rise)	531	Mini-Mart Convenience Store
353	Store, Retail	532	Florist Shop
356	Classroom (Elementary and Secondary School)	533	Warehouse Food Store
358	Gymnasium (Elementary and Secondary School)	534	Warehouse Showroom Store
363	Physical Education Building (Elementary and Secondary School)	540	Motel Room, 2 Story, Double Row
364	Science Classrooms (Elementary and Secondary School)	543	Motel Room, 1 Story, Single Row
365	Elementary School (Entire)	544	Office-Apartment (Motel)
368	Classroom (College)	552	Recreational Enclosure
369	Commons (College)	554	Shed Office Structure
370	Gymnasium (College)	555	Quonset, Light Commercial Arch-Rib
372	Library, College	556	Storage, Bulk Oil
373	Technical Trades Building (College)	557	Quonset, Farm Utility Arch-Rib
376	Science Building (College)	558	Quonset, Farm Implement Arch-Rib
377	College (Entire)	561	Shed, Feeder Barn
378	Stable	562	Shed, Farm Commodity Storage
379	Theater, Live Stage	566	Shelter, Farm Sun Shade
380	Theater, Cinema	571	Passenger Terminal
381	Veterinary Hospital	574	Visitor Center
384	Barber Shop	577	Parking Levels
386	Warehouse, Mini	578	Mini Bank
387	Warehouse, Transit	580	Truck Stop
390	Storage, Lumber Building, Vertical	581	Post Office, Main
391	Storage, Material Building	582	Post Office, Branch
392	Industrial Engineering Building	584	Warehouse, Mega
393	Labor Dormitory	585	Penthouse, Mechanical
396	Hog Barn	588	Motel, Extended Stay
397	Sheep Barn	589	Multiple Residence, Assisted Living (Low

OCCID	Definition	OCCID	Definition
			Rise)
403	Shower Building	594	Hotel, Full Service
406	Warehouse, Storage	595	Hotel, Limited Service
407	Warehouse, Distribution	597	Retail Mixed with Office Units
408	Service Station	598	Relocatable Classroom
409	T-Hangar	600	Administration Building
410	Automotive Center	700	Store, Department, Mall Anchor
413	Shopping Center, Community	710	Retirement Community Complex (Multiple Residence)
414	Shopping Center, Regional	984	Luxury Apartment (High Rise)
418	Health Club	987	Multiple Residence (Low Rise), Interior Space
419	Market, Convenience	993	Office Building, Interior Space

During the inventory, the replacement value for nonresidential structures containing multiple businesses (e.g., a strip mall) was calculated with each business' M&S occupancy code representing a percentage of the total structure (e.g., a strip mall contained 70 percent retail and 30 percent fast-food restaurant).

2.3 Structure Values

Relevant data for each structure was entered into the M&S Residential Estimator and Commercial Estimator programs. The M&S programs were used to calculate depreciated replacement values for each residential and nonresidential structure based on the concepts of effective age, quality, condition, and other structural parameters. The depreciated replacement values were based on the most recently released M&S quarterly values (December 2008 for residential and January 2009 for nonresidential).

Because the survey teams did not enter the interior of any structures, a number of characteristics typically entered into the M&S programs—such as the method of heating and cooling, type of plumbing, and the type of interior floor covering—could not be recorded. Default values were used for characteristics that could not be determined during the structure inventory.

2.4 Tax Assessor Data

Tax assessor databases typically record multiple values for each property, such as land value, improvement value, and total value. Because improvement value captures the value of any structures built on the land, it was used as the tax assessor structure value to compare to the replacement values calculated by M&S.

Major structure characteristics in the tax assessor data were compared with those in the field data to determine the presence of inconsistencies or trends in either set of data. The square footage¹ data field present in the residential tax assessor data is a major factor in structure value. For

¹ Square footage refers to the total square feet for a given structure, not the square footage of the structure's footprint. The square footages collected in the field take into account the number of stories for each structure.

structures located within Fargo, these values in the tax assessor data did not exactly match the field estimates, but the values were close. The tax assessor data generally records to the nearest whole square foot. Field-collected square footage data were estimated from outside of the structures using aerial photographs.

The structure square footage data in the Fargo tax assessor database was found to be fairly accurate. Therefore, in cases for which square footage field estimates were more than 20 percent different from the tax assessor data, the square footage value from the tax assessor data was used to calculate the depreciated structure value. If a square footage estimate was less than 20 percent off from the tax assessor data then the field data was used. Adjusting the square footage values provided a more direct comparison between the tax assessor value and the M&S value since square footage is one of the major drivers in calculating a structure value. The depreciated residential structure values from the M&S programs were approximately 5 percent greater than the depreciated structure values from tax assessor data for Fargo.

The Moorhead structures did not have the same discrepancies in the field square footage versus tax assessor square footage. Therefore the field data was determined to be more accurate for the Minnesota side of the study area so no adjustments were made to the collected data. For Moorhead, the depreciated residential structure values from the M&S programs were approximately 30 percent greater than the tax assessor values.

With the discrepancies in the Fargo field data and the considerable differences between the Fargo and Moorhead adjustment factors, URS conducted additional analyses of residential structures in the City of Fargo to determine if the M&S residential structure values are really within 4 to 5 percent of the tax assessor value. The City of Fargo tax assessor provided a more detailed file than what was originally provided on a set of structures selected by the St. Paul District from the city's database. This file contained the size of the basements as a percentage of the footprint (None, 25 percent, 50 percent, 75 percent, or 100 percent) and the percent of basement that is finished.

This more detailed tax data was entered into the M&S residential program. All residential data was entered into the M&S program as recorded by the tax assessor, including the specific heating type; none of the field data was used. The one exception was "Franklin stoves" which were entered as fireplaces because that was the closest option in the software. Because of the time it takes to manually enter structures into M&S, approximately 380 residential structures were valued this way.

Using the revised structure values, an updated adjustment factor was calculated for residential structures in the City of Fargo. The updated adjustment factor resulted in a 28 percent increase in the tax assessor improvement values. This result is closer to the findings in Moorhead and similar studies conducted previously in Fargo by St. Paul District. A large component of the increase resulted from entering characteristics of finished basements.

2.5 Results

A total of 10,460 residential and nonresidential structures were inventoried during the field work. In the final analysis 7,233 nonresidential structures and 804 residential structures were used (Table 2). One-and-half-story structures are captured in the appropriate one-story category.

Table 2: Number of Structures Inventoried

Structure Type	Number Inventoried
Residential	
One Story, With Basement	583
One Story, No Basement	18
Two Story, With Basement	147
Two Story, No Basement	36
Bilevel/Split-Level	20
Total Residential	804
Nonresidential	
Commercial	7,189
Industrial	5
Agricultural	39
Total Nonresidential	7,233

Table 3 provides descriptive statistics about the residential structures inventoried. One-and-half-story structures are captured in the appropriate one-story category.

Table 3: Descriptive Statistics for Residential Structures

Category	Average	Maximum	Minimum	Standard Deviation
One Story, With Basement				
Square feet	1,385	9,140	480	593.5
Depreciated replacement value	\$127,802	\$961,258	\$57,721	\$56,842.5
One Story, No Basement				
Square feet	1,120	1,836	528	326.9
Depreciated replacement value	\$91,505	\$172,574	\$47,422	\$34,399.1
Two Story, With Basement				
Square feet	2,251	5,000	884	906.2
Depreciated replacement value	\$191,212	\$554,165	\$81,816	\$100,436.0
Two Story, No Basement				
Square feet	1,580	1,700	830	156.8
Depreciated replacement value	\$100,362	\$111,716	\$65,320	\$9,834.1
Split-Level/Bi-Level				
Square feet	2,273	3,000	1,440	517.2
Depreciated replacement value	\$187,957	\$244,958	\$112,946	\$31,804.2

Table 4 provides descriptive statistics about the nonresidential structures collected during the inventory.

Table 4: Descriptive Statistics for Nonresidential Structures

Category	Average	Maximum	Minimum	Standard Deviation
Commercial (General)				
Square Feet	15,080	509,460	30	31,283
Depreciated replacement value	\$1,295,158	\$110,035,558	\$241	\$3,758,049
Industrial				
Square Feet	15,802	27,470	2,000	10,862.2
Depreciated replacement value	\$1,182,878	\$3,084,140	\$256,183	\$1,198,789.9
Agricultural				
Square Feet	2,027	33,660	110	6,030
Depreciated replacement value	\$30,260	\$601,877	\$794	\$100,397

Each nonresidential structure inventoried was assigned two depth-damage functions (DDFs): one to represent the structure and the other to represent the contents. The DDFs were provided by the St. Paul District. The DDF assigned to the structure was based on the construction type of the structure, while the DDF assigned to the contents was based on the type of business/activities conducted in the structure.

Once the URS data was analyzed it needed to be connected to the St. Paul District's data files in order to update the structure elevations and structure values. The St. Paul District provided five Hydrologic Engineering Center – Flood Damage Analysis (HEC-FDA) formatted files, which included two files for the City of Fargo, two files for Cass County, and one file for the City of Moorhead. Because the St. Paul District files reflect information on parcels and the URS files reflect information on structures, creating a specific match when multiple structures exist on a single parcel proved problematic. A detail methodology outline employed by URS to address this and other issues is provided in Appendix A.

Once a crosswalk between the tax assessor database, USACE database, and URS database was completed, the final HEC-FDA files were updated with new structure values and elevations and submitted to the St. Paul District. The hydrologic and hydraulic (H&H) data used by the St. Paul District were imported into the ArcMap software to ensure the correct river station numbers were assigned to the structures based on building location, not tax parcel, or nearest tax parcel.

These HEC-FDA data files were delivered to the St. Paul District in several formats. Data relevant to the economic analysis was provided in the HEC-FDA program format. Backup data was provided on a compact disc, including the field database containing the information collected during the inventory, field photographs, and a spreadsheet showing the factors used to adjust the Fargo and Clay County tax values to the current M&S depreciated replacement values.

3.0 NONRESIDENTIAL SURVEYS

Most nonresidential structures can be sorted into one of the DDFs discussed previously. However, some structures are unique and not represented well by the DDFs or have subterranean levels that are not accounted for with the DDFs. The purpose of the nonresidential surveys was to obtain data to more accurately estimate potential flood damages of the contents of unique structures than can be estimated by the indirect DDFs. Data were collected at selected facilities and used to calculate DDFs for the contents of each structure at the facility, cleanup costs, and other valuable items on the property (e.g., equipment stored in a maintenance yard). The resulting direct DDFs replaced the indirect DDFs originally assigned to the structure. Direct DDFs calculate damages in direct dollar amounts while indirect DDFs calculate the damages as a percent of the total damage value. To collect the data, URS developed a survey instrument that asked respondents to provide information on historical flood damages and to estimate damages for different levels of flooding. The surveys were completed through interviews conducted with representatives of the selected facilities.

3.1 Survey Instrument

The survey instrument was developed based on surveys that had been previously developed for other studies. Prior to conducting any interviews, OMB approval of the survey instrument was required. URS prepared an information package containing basic information on the purpose of the survey, the selection of facilities, and the basis from which the survey instrument was derived. The information package was submitted to OMB through the USACE Mississippi Valley Division and was approved for use in January 2009 (Appendix B).

The survey instrument steps respondents through the process of identifying the placement and value of contents within each structure at a facility. Respondents were asked to separate the contents into three categories (equipment, furniture, and inventory/products), and indicate the placement and value for each category. Respondents were then asked to estimate the amount of damage that would occur if the structure flooded. For the amount of damage, respondents were asked to provide a low, most likely, and high value to account for uncertainty. In addition to the contents in the structures, respondents were asked to identify cleanup costs (if the facility had been flooded previously) and hypothetical preparedness costs if flooding were imminent. Other items of value that may be located on the facility grounds were also noted.

3.2 Selection of Facilities to Interview

A separate goal of the inventory was to determine which nonresidential structures warranted an interview. The selection of these facilities was conducted prior to the inventory and focused on industrial-type facilities that appeared to contain unique or expensive contents. The initial list was developed by Houston Engineering (a URS subcontractor) based on large improvement values obtained from the tax assessors' databases. This list was then revised to account for field observations and Houston Engineering's knowledge of the area. Finally, URS and Houston Engineering held discussions with the St. Paul District to finalize the list of selected facilities.

Houston Engineering contacted the 66 facilities identified in Table 5 for interviews.

Table 5: Facilities Contacted for Interviews

Company	Survey Status	Company	Survey Status
702 Communications	Completed	Gremada Industries	Unavailable
Air National Guard	Incomplete	Hector International Airport	Completed
Alien Technology Corporation	Completed	Hjemkomst Center	Completed
American Crystal Sugar	Completed	Ideaone	Completed
American Steel	Unavailable	Infinity Windows	Completed
American Steel Systems	Unavailable	Integrity Windows (2 locations)	Completed
BNSF Railway	No Response	Johnston Fargo Culvert	Unavailable
Cardinal Insulating Glass Co	No Response	Knight Printing	Unavailable
Cargill Oil Seed	Completed	Larkin Properties LLP	No Response
Cass Clay Creamery	Completed	McNeilus Steel	Completed
Clay County Law Enforcement	Completed	Meritcare – South University	Completed
CNH America LLC	Completed	Microsoft Corporation	No Response
Cretex Concrete Products North	Completed	Mid America Steel Inc.	Completed
D&M Industries	Declined	Minnkota Windows	Unavailable
Dacotah Paper	Completed	Nash-Finch Co	No Response
Dakota Fence	Declined	National Guard Recruiting Station	No Response
Dakota Specialty Milling	Incomplete	NDDOT	Completed
Drayton Enterprise	No Response	NDSU	No Response
DS Beverages Inc: Anheuser-Busch Red Hook & Monster	No Response	Nordick Group Inc.	Declined
Eventide Senior Living Communities	Completed	Northern Pipe Products Inc.	Completed
FAA- Airport	Declined	Northern Water Works Supply	Completed
Fargo Park District (Edgewood Golf Course)	Completed	Pan-O-Gold Baking Co	Completed
Fargo Parts & Equipment	Declined	Phoenix International Corp. (2 locations)	Completed
Fargo Public Library	No Response	Phyllis Thurlow	No Response
Fargo Tank & Steel	Unavailable	PRACS	No Response
Fargo Wastewater Treatment Plant	Completed	Qwest Corporate Communications	Completed
Fargo Water Equipment Co	Unavailable	RDO Equipment	No Response
Fargo Water Treatment Plant	Completed	Sara Lee Bakery Group	No Response
Fargodome	Completed	Smurfit-Stone Container Corporation	Completed
Ferguson Enterprises	Completed	Swanston Equipment	No Response
Gary Westerholm & Timothy Dockter	No Response	Tecton Products	No Response
Gem of Fargo LLC	Completed	The Forum	No Response
GPK Products Inc	Completed	Trollwood Performing Arts School	Completed

3.3 Contact and Interview Process

Houston Engineering initially contacted the majority of the selected facilities by telephone and some by site visits. Efforts were made to obtain the contact information for the persons deemed best suited to participate in the interview, such as business owners, office managers, or facilities engineers. When possible, respondents were provided with the survey questionnaire and cover letter by e-mail prior to the scheduled interview. A majority of the surveys were conducted in person; however, a few preferred to respond by e-mail. Multiple follow-up phone calls and e-mails were exchanged with the selected facilities to ensure as many responses as possible (contacts and attempted contacts were recorded). Despite multiple follow-ups, some facilities either declined interviews or simply did not respond to inquiries.

During the interviews process, some respondents had difficulty estimating the damages to their facilities. Business owners and facilities managers were best able to address the questions on the survey. Office managers were not as familiar with the value of the contents and often had difficulty answering the questions. Thirty-three surveys were completed, resulting in the collection of information for 86 structures.

3.4 Analysis of Survey Data

Direct DDFs for contents were calculated for the structures at facilities where interviews were conducted. The direct DDFs were calculated by multiplying the total value of the contents for each category by the percent damage at each level of inundation. The estimated damages for the three categories (equipment, furniture, and inventory/products) were aggregated by depth to estimate the total damage at each level of flooding. These calculations were conducted for each of the uncertainty values (low, most likely, and high). The resulting flood damage levels, which were unique to each structure, ranged anywhere from -27.5 to 6 feet above the ground elevation.

In addition to estimating the potential damages to contents, respondents were also asked to provide information on clean-up costs (if the respondent had been flooded previously), valuable property on the grounds, and potential flood damage reduction measures they would undertake if flooding was imminent. When respondents provided this information, an other² category was used to represent the cost to implement flood preparedness measures. These DDFs started at -2 feet, with the assumption that emergency preparedness plans would begin to be implemented when the elevation of the water was within 2 feet of the elevation of the structure.

Data obtained from the surveys were provided to the St. Paul District in a HEC-FDA program compatible format. This information is not presented in this report to maintain the confidentiality of the facilities surveyed.

² 'Other' refers to any costs indicated by the respondent that cannot be captured in the structure damage category or content damage category.

4.0 FIRST FLOOR AND GROUND ELEVATIONS

Professional land surveyors were used to collect first floor elevations (FFE) and ground elevations for a random sample of 300 structures. The FFEs for the selected structures were then compared to the FFE values provided in the HEC-FDA files. FFE values in the St. Paul District's Moorhead HEC-FDA files were directly compared to the FFE values collected by surveyors for Moorhead. In the St. Paul District's Fargo HEC-FDA files, the ground elevation values were added to the foundation height values and then compared to the FFE values collected by surveyors for Fargo.

A statistical analysis of the results was performed to determine the differences in elevation values in each study area. For Fargo, the surveyed FFE was approximately 1.8 feet higher on average than the FFE provided by the St. Paul District. For Moorhead, the difference was approximately 1 foot. The findings were documented on a spreadsheet and provided to the St. Paul District.

5.0 SUMMARY

The structure inventory and nonresidential interviews were conducted to produce data necessary for the Fargo-Moorhead Feasibility Study economic analysis. The data consisted of two components: a structure inventory and nonresidential survey. The structure inventory provides a representative account of selected structures located in the flood plain for the 0.2-percent-annual-chance event (500-year floodplain) along the Red River of the North and several tributaries within the Fargo-Moorhead metropolitan area. The data gathered was used to determine the depreciated replacement values for the residential and nonresidential structures. The survey included interviews conducted at selected nonresidential facilities to develop unique DDFs for content damages and emergency preparedness costs. The resulting data from the structural inventory and nonresidential interviews was compiled into the HEC-FDA format and delivered to the St. Paul District. This report has been reviewed by the St. Paul District and all comments have been addressed in the final report. Comments are provided in Appendix C.

APPENDIX A

URS METHODOLOGY

URS Methodology

1. Industrial Interviews

- Identification of facilities to interview
 - Initial priority list was developed by Houston Engineering based on characteristics contained in the assessor's database (e.g., heavy manufacturing) and large improvement values.
 - Initial priority list was revised to account for field observations and knowledge of the area (e.g., waste water plant was moved higher in priority list).
 - Discussions were held with the USACE to finalize the list.
- Interviews
 - Houston Engineering initially contacted the majority of the indentified facilities by telephone, other facilities were visited in-person (drop by).
 - The interviewer asked to speak to the appropriate person (e.g., facility manager, owner).
 - When possible, respondents were provided with the survey questionnaire and cover letter by e-mail prior to the scheduled interview.
 - A majority of the interviews were conducted in-person with respondents.
 - Some respondents preferred to respond by e-mail.
 - The data from the surveys were recorded on paper and later transferred to an electronic database.
- Development of content depth damage function (DDF) for each structure
 - The total content value (Questions 15) was multiplied by the estimated percent damage (Question 17) for the three categories (equipment, furniture, and inventory) to determine the dollar damage for each level of flooding.
 - The estimated dollar damages for the categories were added together to determine the total dollar damage for contents.
 - The DDF for contents was created based on the estimated damages for each level of flooding.
- Development of structure DDF for each structure
 - The characteristics of the structures were obtained during the structure inventory.
 - The structure characteristics were used to estimate a depreciated structure value using Marshall & Swift (M&S) commercial estimating program.
 - The HEC-FDA data provided by the USACE was reviewed to determine the DDF that was assigned to the structure.
 - The percent damage assigned to the structure was obtained from the USACE provided curves.
 - The structure component of the DDF was multiplied by the structure value to determine dollar damage for the structure.
 - The DDF for each structure was created based on the estimated damages for each level of flooding.
- Development of "other" DDF for each structure

- Information obtained from the interviews was reviewed to determine if additional damages or costs (e.g., emergency response costs) were provided.
- Information provided from respondents on emergency response costs was calculated into “other” category for the DDF.
- The emergency response was assumed to begin when flooding was predicted to be within 2 feet of the first floor elevation (FFE), therefore the damages were assigned as one time costs starting at -2 feet of the FFE.
- The direct DDFs developed for each structure were incorporated into a text file that could be imported into HEC-FDA.

2. Preparing Database for Field Collection

- URS received tax assessor databases from USACE and provided a hard copy of the Federal Emergency Management Agency (FEMA) 500-year floodplain map for the area.
- The floodplain map was then digitized in ArcGIS to define the boundaries for the structure inventory fieldwork.
- Structures from the tax assessor database were imported into ArcGIS. Any structure outside of the floodplain boundaries was assumed to be outside of the study area and removed.
- Any structure classified as commercial by the tax assessor was kept for the field collection database. Residential structures were randomly selected from within the study area in order to calculate adjustment factors. Ten percent, or approximately 3,000 residential structures, was determined as a sufficient for the adjustment factor calculations and was the stipulated amount in the scope of work.
 - After the initial random selection of residential structures, they were reviewed to ensure that an adequate number of structures would be collected in each tax assessor area. Because the tax assessment practices may be different in each area, enough data was collected to calculate an adjustment factor per area.
 - Large mobile home parks were removed from the database to allow the field crews to focus on permanent structures.
 - The West Fargo database was found to contain insufficient information.
 - Structures were selected and classified as either residential or nonresidential by hand from the aerial photos. Any misclassification was corrected during field collection.
- The large study area was broken into smaller survey areas in order to divide the field collection effort among the survey teams. Main roads were typically used as dividing lines.
- The database was loaded into the field data collection tool according to the steps outlined in the software’s Administration Guide.
- The required software, aerial photos, and field data collection tool database was loaded onto each field computer. The software was tested on each computer prior to beginning field collection to ensure it was installed correctly and working properly.

3. First Floor Elevations

- Surveyors from Houston Engineering and the URS Minneapolis office were used to collect ground elevations and FFEs for a random sample of 300 structures.
- FFEs for the selected structures were compared to the FFE values provided in the USACE's HEC-FDA files.
 - For Moorhead, the FFEs listed in the USACE's HEC-FDA files were compared directly to the FFEs provided by the surveyors.
 - For Fargo, the FFEs for the structures contained in the USACE's HEC-FDA files were determined by adding the ground elevation to the foundation height.
- A statistical analysis of the results was conducted showing the differences in elevation values for each study area.
 - The FFEs obtained from the surveyors were used as the base value.
 - The USACE-estimated FFEs were used as the experimental values.
 - The actual differences (in feet) were used for the uncertainty analysis.
- A spreadsheet containing the evaluated structures and findings was provided to the USACE.

4. Structure Inventory Field Collection

- All surveyors received training prior to beginning fieldwork to ensure each team collected data under the same set of assumptions. Some data fields (effective age) can be more subjective than others (square footage); therefore, the training focused on improving consistency across surveyors for these fields.
- Each surveyor was also given time to become familiar with using the field data collection tool prior to the start of field work.
- Detailed reference guides were provided to each surveyor and put in each field vehicle in case questions arose in the field.
- All characteristics required for evaluation in the M&S software (square footage, effective age, quality, condition, exterior wall type, roof type, occupancy type if nonresidential, etc.) were collected by the survey teams. Photographs of all inventoried structures were taken.
- Three or four survey teams (depending on the week of field work) collected data at the same time. Daily debriefs occurred at the end of each day to discuss problems experienced in the field and to gauge progress towards completion.
- Field teams rotated partners throughout the data collection process to help ensure consistency across the surveyors.
- Field teams were instructed to drive each road in their assigned survey areas in case nonresidential structures existed that were not identified within the database.
- If the database indicated that a structure should be present that was in fact not present, not a structure (electrical box, etc.), or had been demolished, the structure was marked as deleted by the survey team with a statement as to why the structure should be deleted.
- If a structure could not be reached by the survey team, it was marked as inaccessible with a statement to why it was inaccessible (gated with no guard, on military base, etc.).

5. Data Analysis

- Structure data collected during fieldwork were entered into the appropriate M&S estimating software program (Residential or Commercial).
- The structure values calculated by the M&S programs were then imported into the main structure database.
- Any nonresidential structures that were identified in the field and added to the database were assigned a PIN based on the tax parcel maps using ArcGIS.
- This PIN number was used to match the USACE data from the HEC-FDA files to the URS structure database. Matches that could not be made directly because of multiple structures with the same PIN number were made by hand. Structures that URS was not able to match to a USACE PIN were placed in a separate file from the matched structures by HEC-FDA area (Fargo North, Fargo South, Cass County North, Cass County South, and Moorhead).
- Residential Structures
 - The M&S structure values were compared to the tax assessor values in order to determine the appropriate adjustment factor for each area.
 - The initial adjustment factors raised questions and additional investigation was required.
 - Additional analysis revealed discrepancies in the square footage between the URS database and the tax assessor database for some of the structures collected in Fargo, most notably bi-level structures.
 - For any structure with a difference in area greater than 20 percent, the URS surveyed area was replaced with the tax assessor's square footage.
 - The M&S dollars per square foot value was then applied to the tax assessor's square footage for these structures and compared to the tax assessor's structure value. This comparison resulted in an adjustment factor of 1.045 or a 4.5 percent increase.
 - The structure values developed by URS for Moorhead were approximately 30 percent greater than the values determined by the tax assessor, resulting in an adjustment factor of 1.30, or a 30 percent increase. This adjustment factor was applied to all residential structures in Moorhead.
 - A sample of the City of Fargo residential structures was re-entered manually into M&S using more detailed information (e.g., the presence of a finished basement) from the tax assessor. This allowed for a more accurate comparison between the tax assessor value and the M&S value.
 - The adjustment factor for the City of Fargo was calculated to be a 28 percent increase. This result is more in line with previous studies in the area, increasing confidence in this set of data.
 - The elevation, station, and DDF were retained from the HEC-FDA file provided by the USACE—besides the structure value increase, the residential structures in the USACE HEC-FDA files were returned unchanged.

- Nonresidential Structures
 - The depreciated structure values developed using M&S were compared to those contained in the tax assessor databases.
 - Significant discrepancies between the two values were identified.
 - Structures with significant discrepancies were evaluated to identify the root cause (e.g., size difference).
 - The field-collected data was evaluated for outliers (e.g., size and \$/sq ft).
 - Structures considered to have outlier values were evaluated to determine if the data was correct.
 - Adjustments were made as appropriate.
 - The DDFs provided by the USACE were assigned to structures based on the occupancy code identified during the field work and the list of DDFs provided by the USACE.
 - Nonresidential structures were assigned the same river station and elevation as contained in the HEC-FDA files provided by the USACE.
 - Structure values for multi-story structures were adjusted by dividing the total structure values by the number of floors to give a single, first-floor value.
 - Apartments with sub-terrain levels were assigned a DDF of Apt2. These apartments were identified by the FFE adjustment that URS determined while in the field.
- Random Sampling
 - A random sample of nonresidential structures was selected and scrutinized in order to identify the reason for the discrepancies between the URS and tax assessor's data.
 - This analysis revealed unreasonably low assessed values in terms of cost per square foot for a majority of structures. Results provided strong justification for URS calculated values.
 - A PowerPoint file containing pictures of each of 40 randomly sampled structures, with adjoining tables comparing the total and per square foot values of the surveyed and assessed areas, was created and provided to the USACE.

APPENDIX B

NONRESIDENTIAL INTERVIEW SURVEY FORM

COMMERCIAL AND INDUSTRIAL FLOOD DAMAGE SURVEY

(Personal Interview)

OMB Control Number: 0710-0001

Expires: 30-Sep-2009

The public report burden for this information collection is estimated to average 40 minutes per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this data collection, including suggestions for reducing this burden, to Department of Defense, Washington Headquarters Services, Executive Services Directorate, Information Management Division, and the Office of Information and Regulatory Affairs, Office of Management and Budget, Washington, D.C. 20503, Attn.: Desk Officer for U.S. Army Corps of Engineers. Respondents should be aware that notwithstanding any other provision of law, an agency may not conduct or sponsor, and a person is not required to respond to, a collection of information unless it displays a currently valid OMB control number. Please DO NOT RETURN your completed form to either of these offices.

***Be sure to notify each person to be interviewed that responding to questions is voluntary.**

**COMMERCIAL AND INDUSTRIAL FLOOD DAMAGE SURVEY
PRIMARY SURVEY FORM**

OMB#: 0710-0001

Expires: 30-Sep-09

Firm Name: _____

***Attach Business
Card Here***

This survey is focused on damages that could occur to the contents of structures at your facility in the event of future flooding. Contents are defined as items that would be relocated in the event that the facility moves to another location, such as furniture, equipment, products, and raw materials. For this survey contents were divided in three categories:

- **Equipment**: Physical items that are used for the production process or the operation of the facility (e.g., generators, machinery, production tables, paint booths, robotics, racks, conveyors, floor scrubbers, computers/servers, etc.). These items would most likely be removed if the business relocates to another facility.
- **Furniture**: Physical items necessary for the conduct of business or delivery of a product (e.g., desks, chairs, bookcases, artwork, etc.). As with equipment, this category is focused on free-standing and attached furniture that would be removed in the event of relocation.
- **Inventory/Products**: Items that are used in the production process or result from the production process, or consumables used as part of the business activities. Items include raw materials, finished products, replacement parts, medical consumables, cleaning products, food, pharmaceuticals, software, building materials, office supplies, etc.

Business Information

Address _____
 Contact Name _____
 Contact's Title _____ Telephone # _____
 Interviewer _____ Date _____ Time _____
 1. Type of business _____
 2. Total number of buildings on site _____
 3. Number of years business has been at this location _____

Flood History and Mitigation

4. Has your facility been flooded in the past? Yes No
If "Yes," please complete Questions 5 and 6. If "No," skip to Question 7.
 5. Please estimate the damages to your business from past flooding events. Please give a single set of combined damages for all floors in all buildings.

Date of the flooding event:		Date of the flooding event:	
Water depth above first floor:		Water depth above first floor:	
Contents damage estimate (\$):		Contents damage estimate (\$):	
Structure damage estimate (\$):		Structure damage estimate (\$):	
Number of lost business days:		Number of lost business days:	
Amount of lost net income (\$):		Amount of lost net income (\$):	
Cost of cleanup (\$):		Cost of cleanup (\$):	

6. Briefly describe any permanent flood mitigation measures that have been implemented to reduce potential flood damage. _____

Building Information

(Questions 7-17 are to be answered for your **primary building only**. If there are multiple buildings at the facility, a supplemental sheet is provided that asks for similar information.)

7. Building #: _____
8. Brief description of function of the building and its contents: _____

9. Year building was constructed: _____
10. Building Construction Type (e.g. brick): _____
11. Number of floors (including basement, if any): _____
12. Building footprint: _____ feet by _____ feet = _____ square feet
13. Does the building have a basement? Yes No If yes: _____ square feet finished area
_____ square feet unfinished area
14. Is there a seasonal variation in the value of inventory in this building? Yes No
If yes, what is the average value of your inventory during the following time periods:
January – March \$ _____ April – June \$ _____
July – September \$ _____ October – December \$ _____
15. Relative to the 1st floor elevation of the building, what is the current value of the contents and where are they located vertically? (up through 1st floor only)

Height (ft)	Equipment (\$)	Furniture (\$)	Inventory/products (\$)
0.0 ft			
1.0 ft			
3.0 ft			
6.0 ft			
Total			

Notes to interviewer:

- Shaded areas are for buildings with a subterranean level only. Please fill in appropriate values for the depth (e.g., -1.0 ft, -3.0 ft, -6.0 ft). Leave shaded areas blank if no subterranean level exists.
- The values in the columns should be a cumulative total, starting from the lowest level of the structure.

Susceptibility to Flood Damage

The amount of damage due to flooding can vary considerably depending on conditions (e.g., quality of water, duration of flood). When completing the following section, you will be asked to provide a range for potential damages. In addition to the most likely damage amount due to flooding, you will also be asked to provide a low and high estimate. Please use the following definitions:

- “Most Likely” – reasonable amount of damage expected to occur during an average flood.
- “Low” – reasonable low estimate of damages assuming that the flood conditions are less than a typical flood (e.g., short duration, relatively clean floodwaters) or the contents were less impacted than typically estimated (e.g., motors were sealed well).

- “High” – reasonable high estimate of damages assuming that the flood conditions are worse than a typical flood (e.g., long duration, highly contaminated floodwaters) or the contents were more impacted than typically estimated (e.g., motors need total replacement).

16. At what elevation, relative to the 1st floor of the building, does flood damage to **contents** begin? (+ or – ; will only be negative if there is a subterranean level) _____ feet
17. Please estimate damage to contents corresponding with water depths above/below the building’s 1st floor elevation. (Express damage in either \$ or % of total value.)

Flood Depth	Equipment			Furniture			Inventory/products		
	Low	Most Likely	High	Low	Most Likely	High	Low	Most Likely	High
0.0 ft									
0.5 ft									
1.0 ft									
3.0 ft									
6.0 ft									

Notes to interviewer:

- Shaded areas are for buildings with a subterranean level only. Please fill in appropriate values for the depth (e.g., -1.0 ft, -3.0 ft, -6.0 ft). Leave shaded areas blank if no subterranean level exists.
- The values in the columns should be a cumulative total, starting from the lowest level of the structure.

Other Information

18. Other than the principal structures, are there any other valuable items on your property that flood waters could damage?
- Not readily movable (landscaping, electrical equipment, pipes, trailers on blocks, etc.)

Type	Current Value (\$)	Height Above Ground (ft.)

- Movable (cars, trucks, trailers, etc.)

Type	Current Value (\$)

19. Emergency Measures/Plans:

a. What emergency measures/plans, if any, would you take to reduce damage if eminent flooding was forewarned? _____

b. What is the estimated cost to implement these emergency measures? \$ _____

c. How much time is required to implement these emergency measures? _____ hours

COMMERCIAL AND INDUSTRIAL FLOOD DAMAGE SURVEY **SUPPLEMENTAL SURVEY FORM**

OMB#: 0710-0001
 Expires: 30-Sep-09

Firm Name: _____

This supplemental survey form is to be used for each additional building at your facility. Information for each building is needed to estimate damages that could occur to the contents of all structures at your facility in the event of future flooding.

1. Building #: _____
2. Brief description of function of the building and its contents: _____

3. Year building was constructed: _____
4. Building Construction Type (e.g. brick): _____
5. Number of floors (including basement, if any): _____
6. Building footprint: _____ feet by _____ feet = _____ square feet
7. Does the building have a basement? Yes No If yes: _____ square feet finished area
 _____ square feet unfinished area
8. Is there a seasonal variation in the value of inventory in this building? Yes No
 If yes, what is the average value of your inventory during the following time periods:
 January – March \$ _____ April – June \$ _____
 July – September \$ _____ October – December \$ _____
9. Relative to the 1st floor elevation of the building, what is the current value of the contents and where are they located vertically? (up through 1st floor only)

Height (ft)	Equipment (\$)	Furniture (\$)	Inventory/products (\$)
0.0 ft			
1.0 ft			
3.0 ft			
6.0 ft			
Total			

Notes to interviewer:

- Shaded areas are for buildings with a subterranean level only. Please fill in appropriate values for the depth (e.g., -1.0 ft, -3.0 ft, -6.0 ft). Leave shaded areas blank if no subterranean level exists.
- The values in the columns should be a cumulative total, starting from the lowest level of the structure.

Susceptibility to Flood Damage

10. At what elevation, relative to the 1st floor of the building, does flood damage to **contents** begin? (+ or – ; will only be negative if there is a subterranean level) _____ feet

11. Please estimate damage to contents corresponding with water depths above/below the building's 1st floor elevation. (Express damage in either **\$ or % of total value.**)

Flood Depth	Equipment			Furniture			Inventory/products		
	Low	Most Likely	High	Low	Most Likely	High	Low	Most Likely	High
0.0 ft									
0.5 ft									
1.0 ft									
3.0 ft									
6.0 ft									

Notes to interviewer:

- Shaded areas are for buildings with a subterranean level only. Please fill in appropriate values for the depth (e.g., -1.0 ft, -3.0 ft, -6.0 ft). Leave shaded areas blank if no subterranean level exists.
- The values in the columns should be a cumulative total, starting from the lowest level of the structure.

APPENDIX C

RESPONSE TO COMMENTS

This appendix contains all comments from the St. Paul District on the draft report and the corresponding URS responses.

Comments from Jeff McGrath:

General Comment: Report looks good; good job of describing procedures, data sources, and products. We should be able to use most, if not all of this, for our own feasibility report.

Comment 1: Page 1, line 1 - Change "...Red River of the North Feasibility Study" to "...Fargo-Moorhead Feasibility Study". Make this change also on Page 13, line 2 of Section 5 Summary.

URS Response: Text changed as requested in both paragraphs in the report.

Comment 2: There are two Page 1's

URS Response: Page numbering corrected.

Comment 3: Section 2, para 2, line 4 - Change "...FEMA a floodplain map..." to "...FEMA's floodplain map..."

URS Response: Text changed as requested.

Comment 4: Page 6, Section 2.4, 2nd paragraph - Does square footage refer to the area of the structure footprint or does it include all floor space of all floors? Please clarify.

URS Response: A footnote was added stating that the term "square footage" includes all floor space from all floors, not just the structure's footprint.

Comment 5: Page 7, line 1 - Does the "5 percent greater" figure refer to just residential structures or to commercial structures as well? Same comment regarding the "30 percent" figure in the next paragraph. Please clarify.

URS Response: These percentages refer to just the residential structures from the tax assessor. The text in both paragraphs has been clarified.

Comment 6: Section 2.5 - Do these results pertain just to Fargo? It seems the number of residential structures inventoried, 381, refers to Fargo. How many residential structures in Moorhead were inventoried. Does the nonresidential figure of 7,233 include Moorhead also? Do Tables 3 and 4 include Moorhead data also?

URS Response: This was an error for the residential figures. When the tables were updated using the Fargo residential values from the manual entry into M&S, the Moorhead

results were inadvertently dropped. The non-residential figures are correct, and include Moorhead and West Fargo, in Tables 2 and 4. The residential figures in Tables 2 and 3 have been corrected to reflect survey efforts and results for Moorhead. There were 423 residential structures inventoried in Moorhead.

Comment 7: Page 9, paragraph 1 - State the source of the DDF's. Are these the new functions from IWR's recent Draft report?

URS Response: The second sentence of this paragraph states that the DDFs were provided by the St. Paul District. If another source should be stated, please let us know the source of the DDFs that were provided to URS. Because DDFs were provided to URS, the new generic curves from IWR were not used.

Comment 8: Page 9, last line - Does "...county data..." refer to the assessor's structure value data? Please clarify. Fargo data comes from Fargo's city assessor.

URS Response: Yes, it is from the assessor's database. This sentence was changed and now reads: "...and a spreadsheet showing the factors used to adjust the Fargo and Clay County tax values..."

Comment 9: Page 10, Section 3.0 - Please describe the difference between indirect DDF's and direct DDF's.

URS Response: The difference between indirect and direct DDFs is now described in the report.

Comments Rick Carlson

Comment 10: Page 2, Section 2.2 Data Collection – For each residential structure, no mention was made on the presence or absence of a basement. Did you also determine the latitude and longitude or was that already provided.

URS Response: A statement that we did collect information on basements and the latitude and longitude has been added to the report.

ATTACHMENT 2
Transportation Analysis

Fargo-Moorhead Metro Feasibility Study

Transportation Analysis

U.S. Army Corps of Engineers
St. Paul District



February 2010

Prepared by:
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Fargo-Moorhead Metro Feasibility Study

Transportation Analysis

February 2010

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Executive Summary

The purpose of this study is to provide a transportation analysis of the effects of a major flood event in the Fargo-Moorhead metropolitan area. The U.S. Army Corps of Engineers (USACE), St. Paul District is investigating the feasibility of installing permanent flood mitigation measures to minimize future flood damage in the area. This study compares the short-term economic impacts of disruption to the transportation system caused by catastrophic flooding events to the transportation impacts resulting from the implementation of a permanent flood mitigation measure in the Fargo-Moorhead metropolitan area.

Our analysis considered the transportation impacts of the March 2009 flood and flood fight in the Fargo-Moorhead area. During the flood fight, roadways along the Red River were submerged or used as footings for temporary levees, central corridors were repurposed as sand bag distribution routes, and roads were congested with emergency vehicles. Based on interviews with a number of key stakeholders, it is clear that the impacts of a failed flood fight would have a much broader and more severe impact. Disruption would extend across transportation modes and include the interstate system.

To quantify the potential transportation impacts from severe flooding, an estimated average annual flood damage amount was generated based on the cost of the travel delay and increased travel time and distance result from rerouting trips for the prevailing transportation modes in the Fargo Moorhead metropolitan area. Trip unit cost was determined based on two factors, driver-related costs and vehicle-related costs. The cumulative costs were then evaluated according to a series of event responses for eight flood recurrence intervals (2-year, 5-year, 10-year, 20-year, 50-year, 100-year, 200-year, and 500-year events). This study considered flood damages for two scenario alternatives, With Project Conditions and Without Project Conditions. Based on our analysis, the estimated Average Annual Flood Damage is \$1,503,000 for Without Project Conditions. In contrast, the With Project Condition incorporating flood diversion alternatives proposed by the St. Paul District would effectively negate flood related transportation impacts within the area. Therefore, the average annual direct transportation benefit of the proposed diversions is \$1,503,000.

Fargo-Moorhead Metro Feasibility Study

Regional Economic Development Study

February 2010

1.0 TRANSPORTATION DELAY ANALYSIS

1.1 Transportation Overview

A major flood event can cause measurable and potentially significant impacts to a transportation network. These effects include:

- Prolonged closure of major highways and arterials
- Delayed rail freight movement
- Delayed truck freight movement
- Airport closure
- Major road congestion resulting from a declared evacuation

The purpose of this study is to provide a transportation analysis of the effects of a major flood event in the Fargo-Moorhead metropolitan area. The U.S. Army Corps of Engineers (USACE), St. Paul District is investigating the feasibility of installing permanent flood mitigation measures to minimize future flood damage in the area. This study compares the short-term economic impacts on the transportation system caused by catastrophic flooding events to the transportation impacts resulting from the implementation of a permanent flood mitigation measure in the Fargo-Moorhead metropolitan area. To determine the transportation cost of flooding, the study examines impacts on the local network, main roadway arterials, rail, transit, and air service. Rerouted trips and travel delays are quantified for each identified travel mode. The study's focus is the additional cost of each trip that is delayed or rerouted during a flood event.¹ Primary study outputs are presented as annualized average dollar costs. Secondary outputs include a narrative analysis of the March 2009 successful flood fight.

The complex nature of the study's scope (addressing multiple modes during an atypical event) and its short timeline dictate a high-level and generalized approach to analysis that draws heavily on assumptions based on input from local stakeholders and nationally available surveys.²

The high-level approach of this analysis assumes a general consistency of transportation activity throughout the duration of the flood event.³ The multi-staged temporal nature of a flood event

¹ The study does not quantify the economic loss of trips cancelled due to flooding nor the related loss of economic activity that does not take place due to transportation network disruption. Additionally, this study does not include the cost of repairing the transportation network caused by flood damage or the flood fight. These costs are taken into account in other portions of the overall feasibility study.

² To effectively compare of the Without Project Condition and the With Project Condition the study holds population and traffic volumes constant at 2009 levels. This assumption may lead to an under estimation of transportation damages as volumes increase over time.

(i.e., progressive flooding and disruption, possible evacuation, and recovery process) warrants a more detailed analysis to fully capture the evolving transportation demands.⁴

1.2 Transportation Methodology

This section provides an overview of the data sources used for this study and the data analysis methods.

Data Gathering

Data gathering for this study included in-person interviews, phone and e-mail correspondences with public agencies and interest groups in the Fargo-Moorhead metropolitan area and the collection of national data figures.

Data Analysis

This study provides a comparative analysis of the short-term economic loss resulting from the transportation network for the Without Project and With Project Alternatives. The Without Project scenario involves a quantitative analysis of the transportation impacts of a catastrophic flood based on present-day conditions. The total cost includes the cost of a flood fight with the assumption that the fight would be lost and the flood would prevail. For the purposes of this study, we will call this scenario the Without-Project Condition (Flood Fight and Flood-Fight Failure). The With Project scenario involves a quantitative analysis of the transportation impacts of new permanent flood control measures put in place, the With Project Condition. The following provides further details on these two conditions.

Without Project Condition

- A. Flood Fight (modeled on the March 2009 event) – The product of this scenario is an anecdotal narrative based on interviews and data collection of traffic and transportation disruption during and after the March 2009 flood fight. This includes the identification of road closures, duration, reroutes, loss of service, and emergency and general traffic management operations. These outputs are used to assist in capturing to the extent possible actions taken and costs involved in a catastrophic flood event.
- B. Flood-Fight Failure – This scenario represents the current conditions along the Red River in the Fargo-Moorhead area. Hydrology layers provided by the St. Paul District were utilized to identify points of disruption along each of the identified transportation corridors, likely reroute corridors, and costs of delays (including fuel, additional maintenance, and opportunity costs). Estimated trips that would occur in this scenario are quantified. Results are presented as damage frequencies that correlate with the USACE provided hydrology.

For the purposes of the USACE study, scenarios A and B of the Without Project Condition are evaluated together as a series of event responses for eight flood recurrence intervals (2-year, 5-year, 10-year, 20-year, 50-year, 100-year, 200-year, and 500-year events).

³ Described in further detail in later sections.

⁴ The North Dakota State University – Upper Great Plains Transportation Institute has already conducted surveys and developed models that examine flood evacuations.

With Project Condition

- A. Condition with New Permanent Flood Control Measures Fully Installed – The St. Paul District stated that the With Project alternative will have a residual risk that will be negligible for transportation. This scenario assumes no transportation disruptions due to flooding events.
- B. Impacts during Construction of Permanent Flood Control Measures – The construction of any With Project alternative could take from 6–9 years to complete. Each alternative would impact roadway and rail traffic and require additional temporary and permanent crossings on the network. This study does not include transportation delay estimates due to construction, but delays could be significant and should be considered as part of any project analysis as the construction plans are made available.

A transportation analysis process was developed that takes into account the drastic change in travel opportunity and behavior during a flooding event. The process includes the following steps (also outlined in Figure 1.1):

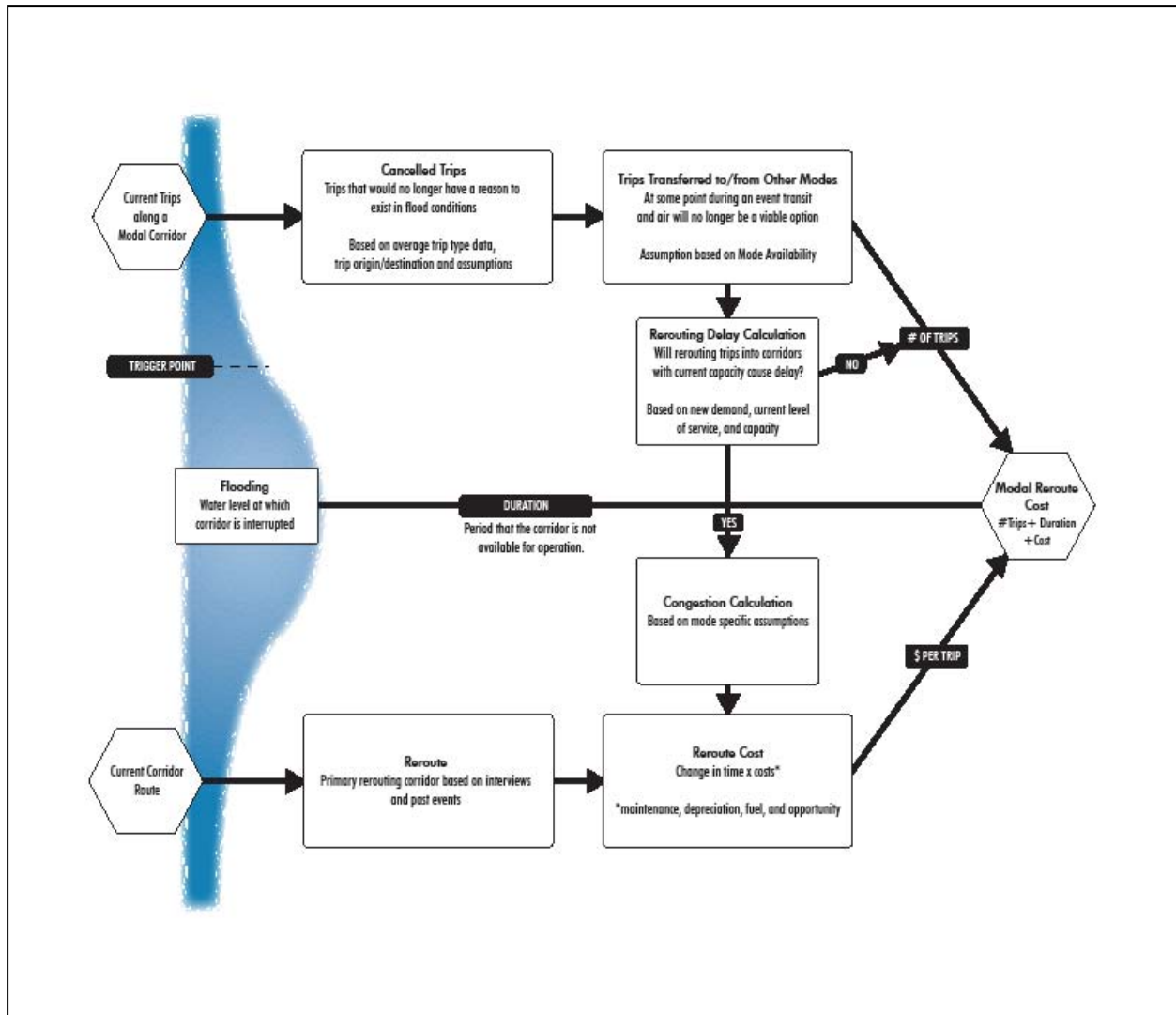


Figure 1-1: Transportation Analysis Process

Step 1 – Corridor Disruption – Each corridor for each identified mode has a point (flood elevation) at which it is no longer viable for transportation use. For secondary roads, highways, and railways, the disruption point occurs when water overtops the corridor itself. Other closures may be caused by secondary actions; some local roads may close in order to accommodate flood-fight activities and the airport may close at a pre-identified flood level. Although the airport may not flood, employees and passengers would not be able to access the airport due to flooded roads.

Step 2 – Event Duration – For the purposes of this study, event duration is the elapsed time from the point that the corridor (or network element) goes offline to the point that it is online again. Event duration includes the time for closure (due to flooding or flood-related causes), recovery, and reconstruction, and culminates when the corridor is reopened. Event duration is calculated based on St. Paul District hydrographs for the Red River and assumptions relating to the length of time it will take to clear flood debris and reopen corridors.

Step 3 – Trip Cancellation and Modal Shift – Travel behavior changes drastically during a flood event. This study assumes that trips to destinations in flooded areas would be cancelled. Residents with flooded properties are less likely to make their regular trips. Some modes (bus transit and air travel) would not be available after a certain disruption point. Many trips on these modes would also be cancelled, and some trips that would have taken place on these modes would be shifted to other modes. Trips in this study are based on existing trip conditions (2009). For the purposes of this study, current land use and transportation conditions are held constant. Trip cancellation estimates are based on national travel behavior surveys (i.e., Journey to Work, National Household Travel Survey, etc.) and local social and demographic information. Trips that were not cancelled, but would have taken place on modes that are no longer available, are assumed to be transferred to auto trips.

Step 4 – Reroute Corridor – For the purposes of this study, a reroute corridor is identified for each primary corridor that is disrupted. The reroute corridor is assumed to absorb all diverted trips from the primary corridor. The difference in travel distance between the primary corridor and the reroute corridor provides the basis for the trip delay estimates. Geo-spatial analysis and flooding reroute assumptions based on past events and stakeholder interviews were used to identify reroute corridors for each mode.

Step 5 – Cost of Delay – Cost of delay is derived by calculating the delay distance and multiplying it by the per mile cost of travel for each mode.

$$\text{Cost of Trip Delay} = (\# \text{ of Trips}) * (\text{Incremental Reroute Cost}) * (\text{Per Unit Cost})$$

Note:

Incremental Reroute Cost = Δ in the time and/or distance resulting from a rerouted trip.

Per Unit Cost = Per unit cost of time and/or distance. For example, the per mile cost of a rerouted trip would involve fuel and vehicle maintenance and depreciation costs per mile. A per minute delay cost would be a function of opportunity cost based on area median family income.

1.3 Transportation Impacts

2009 Flood Fight

Examining the successful flood fight of March 2009 is an important element in projecting transportation impacts of future flood events. The 2009 flood fight presented extensive transportation challenges to the road network as water levels forced road closures at all levels radiating from the Red River, including a portion of Interstate 29 (I-29), the major north-south interstate that runs through the City of Fargo). Impairment of the road network not only affected private auto trips, which is the prevalent mode of transportation in the area, but also severely diminished capacity in public transportation (including paratransit) and caused schedule delays in truck freight and intercity bus service. Rail and air transportation were fully operational during the flood fight and experienced no closures or delays.



(Photo Courtesy of Cass County Government)

Figure 1-2: A Cass County Road on March 28, 2009

The 2009 flood fight included extensive inter- and intra-agency cooperation to address transportation needs at the local, county, State, and Federal levels. North Dakota Governor John Hoeven declared a statewide emergency flood disaster and activated 500 National Guard troops on March 13, 2009 (Cass County Sheriff's Office 2009). On the same day, City of Fargo Mayor Dennis Walaker asked businesses to close and non-essential employees to return home. Road closures commenced on March 18, 2009, with Oak Street closed from 8 Avenue N to 12 Avenue N. The City of Fargo closed the road to facilitate completion of an emergency levee. Over the next 6 days, 39 municipal arterial and collector roads were closed. Numerous local roads were also closed (pers. Comm. City of Fargo).⁵ Duration of arterial and collector road closures ranged from 2 days to accommodate flood-fight activities⁶ to 74 days⁷ to accommodate flood wall construction. At the county level, segments of county roads were closed in Cass County. Six county roads are located either within the jurisdiction of the City of Fargo or along its periphery.⁸ County roads 31 and 22 were closed along the northern edge of Fargo. County road 31 was closed from March 29 through May 6. County Road 22 was closed from March 30 through May 1. Closures for these two roads averaged 35 days. The remaining County roads were either protected or managed by the City of Fargo. I-29 was reduced to one lane beginning March 25 as drain plugs were installed.

⁵ Due to resource constraints and minimal traffic impacts from the local roads, data on the local roads were not provided.

⁶ University Drive from 32 Avenue North to County road 20.

⁷ Elm Street from 14 Avenue North to 15 Avenue North.

⁸ County roads 81, 6, 17, 20, 31, and 22.



(Photo Courtesy of North Dakota Department of Transportation (NDDOT))

Figure 1-3: 2009 Flood: Interstate 29

The Metro Area Transit (MAT) ran buses on a reduced schedule during the flood fight. On March 25, road conditions caused problems that resulted in a further reduction of transit service. On March 26, buses on five routes were removed from service to transport volunteers for the flood fight. Additional buses were pulled on March 27 and March 30 for flood relief. On affected routes, no service was provided due to flooding on March 28. Service on specific routes was suspended on March 30 and some bus service was cancelled on March 31. Paratransit for the City of Fargo was diminished to only one vehicle at times.

The 2009 flood fight was uniquely successful. Environmental, temporal, and human elements combined to prevent large-scale flooding during an event of greater than 100-year severity. This level of success, and luck, cannot be assumed for future events. For the purposes of this study, a 100-year or greater flood is assumed to lead to levee breaches and some degree of flooding within in the study area.

Individual Modal Analysis

The study addresses each mode individually to take into account each mode's unique characteristics and variables. The discussions below summarize each mode's profile and assumptions, identified reroutes, and trip value calculations:

Roadway Network Analysis

The roadway network is divided into three sub-modal calculations: local private traffic, regional private traffic, and truck freight traffic.

Local Private Traffic

- Profile and Assumptions – Local traffic along the Red River will be disrupted long before any catastrophic flooding takes place. The 2009 flood fight demonstrated that extensive closures are needed to mobilize volunteers and prepare sandbags, and that roadways close to the river often provide the foundation for temporary levees. Local traffic would be further reduced by calls from the city and State government for businesses to close and residents to stay home. For these reasons, local traffic is addressed separately from the regional traffic that would be less severely constrained by a flood event.
- Reroutes – Rerouted private auto trips crossing the Red River would be directed along the nearest unaffected East/West corridors depending on the affected corridor and the level of flooding. Local disruption during the flood fight and flooding event is treated with a general multiplier.
- Calculations – Table 1.1 outlines the cumulative cost of rerouting local private auto trips. The cost is a function of several variables. In particular, the additional distance traveled as a result of a detour, number of trips that are likely to still take place during a flood, and the additional time required to complete the detour, were estimated. These variables were combined with the average vehicle maintenance cost and the opportunity cost of a private auto trip (Table 1.2), as well as the opportunity cost of the driver, to collectively calculate the cumulative cost of rerouting local private auto trips.

Table 1-1: Daily Auto Rerouting Cost from Disruption of Major Roadway Corridors by Severity of Flood Event

	Flood Event*	Number of Trips**	Adjusted Trips *****	Total Trip Miles	Average Vehicle Maintenance Costs (Mileage Related)	Time (hh:mm:ss)	Opportunity Costs (Time Related)	Total Costs
Local Disruption	>=50-year	***	8,000	32,000	\$ 10,347	800:00:00	\$ 51,362	\$ 61,709
Local Disruption	100-year	***	10,400	41,600	\$ 13,451	1040:00:00	\$ 66,771	\$ 80,222
Local Disruption	200-year	***	12,800	51,200	\$ 16,556	1280:00:00	\$ 82,179	\$ 98,735
Local Disruption	500-year	***	19,200	76,800	\$ 24,833	1920:00:00	\$ 123,269	\$ 148,102
Main St./US10	50-year	20,600	5,606	28,030	\$ 9,064	840:54:25	\$ 35,992	\$ 45,056
Main St./US10	<=100-year	20,600	2,060	539,720	\$ 174,518	9716:20:00	\$ 241,663	\$ 416,181
NP Ave	50-year	7,600	2,068	10,341	\$ 3,344	310:14:15	\$ 13,279	\$ 16,623
NP Ave	<=100-year	7,600	760	199,120	\$ 64,385	3584:40:00	\$ 26,584	\$ 90,970
1st Ave.	50-year	16,600	4,517	22,587	\$ 7,304	677:37:26	\$ 29,003	\$ 36,307
1st Ave.	<=100-year	16,600	1,660	434,920	\$ 140,631	7829:40:00	\$ 194,738	\$ 335,369
12th Ave.	<=20-year	1,475	401	2,007	\$ 649	60:12:38	\$ 2,577	\$ 3,226
12th Ave.	<=100-year	1,475	148	38,645	\$ 12,496	695:42:30	\$ 17,304	\$ 29,799
Broadway	50-year	2,425	660	3,300	\$ 1,067	98:59:25	\$ 4,237	\$ 5,304
Broadway	<=100-year	2,425	243	63,535	\$ 20,544	1143:47:30	\$ 28,448	\$ 48,992
I-94 Auto	<=100-year	48,000	4,800	1,257,600	\$ 406,645	22640:00:00	\$ 327,449	\$ 734,093
I-29 Auto	<=50-year	30,200	8,219	78,076	\$ 25,246	38764:15:48	\$ 560,658	\$ 585,904

* For each rerouting option, the designated Flood Event indicates the threshold at which the corridor would be affected. The study assumes a failed flood fight at a severity between a 50- and 100-year event.

** Number of Trips enumerates auto trips that occur on a typical day.

*** Local Disruption indicates access limitations on local streets along the river during flood-fight activities. Local disruption has a non-linear increase as flood severity increases.

***** Adjusted Trips enumerates the auto trips that would occur during a flood event.

Table 1-2: Average Vehicle Maintenance Cost per Mile (Mileage-Related Costs)⁹

Vehicle Cost per Mile (2009)*		
Gas	\$	0.10
Maintenance	\$	0.05
Tires	\$	0.01
Depreciation	\$	0.15
Air Pollution	\$	0.02
cost per mile for average passenger car	\$	0.32

Opportunity cost of private auto trips was calculated using the USACE cost-of-delay process (Table 1.3) (USACE 2004). The cost-of-delay calculation involved a three-tiered criteria based on length of trip delay (0–5 minutes, 6–15 minutes, and more than 15 minutes). The trip type is based on the personal value of time saved and was categorized as either work or non-work. USACE multipliers were applied to each trip type for each delay range based on a percentage of the median income of the Fargo-Moorhead Metropolitan Statistical Area (MSA). Non-work trips are designated as social/recreational trips in Table 1.3. In accordance with the USACE process, work trip-delay costs undergo a vehicle occupancy rate multiplier. For trips delayed more than 1 hour, an average hourly salary was used to calculate the cost of delay.

Table 1-3: Opportunity Cost of a Private Auto Trip (Time-Related Costs)

Delay Range		% of hourly salary (Median Family Income)		Median Family Income - Fargo MSA
				\$50,331
0-5 Minutes	Work Trips	6.40%	\$	1.55
	Social/Recreational	1.30%	\$	0.31
6-15 minutes	Work Trips	32.20%	\$	7.79
	Social/Recreational	23.10%	\$	5.59
>15 Minutes	Work Trips	53.80%	\$	13.02
	Social Recreational	60%	\$	14.52
> 1 hour	All Trips =	Trip Time *	\$	24.20

*USACE, 2004 ER 1105-2-100, Median Income from the 2008 US Census estimate

Regional Private Traffic

- Profile and Assumptions – The study defines regional traffic as private auto trips that originate or conclude at a destination outside of the metro area or trips that utilize the highway system. These trips were broken into East/West (I-94 and Route 10) and

⁹ Based on AAA 2009 "Your Driving Costs." Depreciation based on 20,000 miles of annual travel per vehicle. Pollution calculation based on Federal Highway Administration (FHWA), Highway Economic Requirements System: Technical Report-2002.

North/South (Route 81/I-29 and Route 75). Regional traffic cancellations were estimated using the Journey to Work survey, and local travel behavior profiles were used to identify trips unlikely to take place during a flooding event.

- Reroutes – Rerouted regional private auto trips would be directed along the nearest unaffected East/West and North/South highway corridors depending on the affected corridor and the level of flooding.
- Calculations – See Local Private Traffic for calculation assumptions.

Truck Freight

- Profile and Assumptions – The study area is primarily a pass-through for regional long-haul trucking. Fargo does have a few triple-trailer staging areas that are used to convert double-trailer rigs coming from Minnesota¹⁰ to triple-trailer rigs heading west. This study assumes that most truck trips will not be cancelled; they will be rerouted around the flood area.
- Reroutes – Rerouted truck freight trips would be directed along the nearest unaffected East/West and North/South highway corridors depending on the affected corridor and the level of flooding.
- Calculations – Table 1.4 provides a breakdown of the vehicle-based and driver-based costs on a per mile basis that motor carriers must absorb in the event of disruption to their travel routes.¹¹ These data were derived from the American Transportation Research Institute.

Table 1-4: Truck Freight Cost of Roadway Disruption per Mile

Truck Freight Marginal Expenses	Costs Per Mile
Vehicle-based	
Fuel-Oil Costs	0.634
Truck/Trailer Lease or Purchase Payments	0.206
Repair and Maintenance	0.092
Fuel Taxes	0.062
Truck Insurance Premiums	0.06
Tires	0.03
Air Pollution	0.05
Driver-based	
Driver Pay	0.441
Driver Benefits	0.126
Driver Bonus Payments	0.036
Total Marginal Costs	\$1.69

Derived from American Transportation Research Institute 2009 Survey. Pollution calculation based on FHWA 2002.

Table 1.5 provides a comparative analysis of per mile and per time rerouting costs for auto and truck trips on I-94 and I-29, the two major Interstates that run through Fargo. See the Local Private Traffic discussion for the methodology used to derive the average vehicle maintenance costs and the opportunity costs.

¹⁰ The State of Minnesota does not allow triple trailers.

¹¹ For this analysis, the per mile costs were applied.

Table 1-5: Auto and Truck Rerouting Cost from Disruption of I-94 and I-29*

	Flood Event	Number of Trips	Adjusted Trips	Total Trip Miles	Mileage-Related Losses	Time	Time-Related Losses	Total Losses
Local Trucks Rerouting								
Trucks I-94	100-year	2,270	1,816	475,792	\$ 826,926	10706:50:00	**	\$ 826,926
Trucks I-29	50-year	1,700	1,360	12,920	\$ 22,455	861:20:00	**	\$ 22,455
Through Traffic on Major Roadways								
Auto I-94	100-year	13,000	3,538	251,184	\$ 81,220	22750:00:00	\$ 565,833	\$ 647,053
Trucks I-94	100-year	2,230	2,230	158,330	\$ 275,178	3902:30:00	**	\$ 275,178
Auto I-29	50-year	11,100	3,021	28,697	\$ 9,279	1913:07:52	\$ 47,583	\$ 56,862
Trucks I-29	50-year	1,300	1,300	12,350	\$ 21,464	823:20:00	**	\$ 21,464

* The existing profile and elevation of I-94 is higher than I-29. I-94 is assumed not to experience any service interruption during a 50-year or smaller flood event, while I-29 would. However, I-94 would experience service interruption during a 100-year or greater flood event.

** Truck calculations are all based on per mile costs.

Transit

Transit trips are very important to the mostly elderly, underage, and non-car owning populations. Disruption of transit service has a disproportionate impact on these groups. These impacts are incorporated in the Other Social Effects (OSE) study. For the purposes of this Study, the MAT's low threshold for service cancellation and limited ridership in the study area (compared to other modes) indicate that it would have marginal impacts on the costs of transportation disruption.

Rail Freight

- **Profile and Assumptions** – The Burlington Northern/Santa Fe (BNSF) Railway runs two rail lines across the Red River within the study area. These lines carry roughly 60 trains per day, with about 80 cars per train. The Southern Minneapolis Line primarily carries western bituminous coal from Wyoming and Montana to locations in Minnesota, Chicago, and Detroit, and along the Mississippi River for further distribution. The Northern Duluth line primarily carries cargo containers from the ports of Seattle and Tacoma. Containers trains switch to the southern line in Fargo and continue east to Minneapolis/St. Paul, Chicago, and Detroit. The Fargo area is primarily a pass through for West/East freight and disruption would have little impact on local freight delivery or manufacturing. BNSF also owns a multimodal yard in Dilworth, MN, that is not currently active.
- **Reroutes** – In a flood diversion situation, coal cars would be transferred to southern BNSF lines through South Dakota. This study assumes containers will be redirected along Union Pacific rail lines through the southern Great Plain States.
- **Calculations** – Table 1.6 provides the estimated total cost per flood event of a rail freight delay for the two main BNSF rail lines that cross into Fargo.¹² The total cost was calculated based on fuel, operation and maintenance, and crew wages per train. Data sources include the Rail Short Haul Intermodal Corridor Case Studies (Foundation for Intermodal Research & Education in Association with the U.S. Department of Transportation and the Federal Railroad Administration), the Association of American Railroads (AAR), and the 2008 BNSF Class I Railroad Annual Report.

Table 1-6: Rail Freight Reroute Cost

Original Route Corridor	Total Reroute Miles	Total Cost of Delay
Southern Minneapolis - Southern Great Northern Railway Bridge	90,000	\$ 47,595,000
Northern Duluth - North Pacific Railway Bridge (Parallel to I-94)	18,000	\$ 9,519,000
		\$ 57,114,000

¹² A 5-day reroute duration is assumed for all flood events of 100-year severity or greater.

Air Travel Analysis

Air Passenger Travel (Hector)

- Profile and assumptions – Hector International Airport is the commercial airport for the greater Fargo-Moorhead area. It is primarily an origin and destination airport and has few connecting flights. Hector was not affected by the 2009 flood; however, airport staff indicated that, in a flooding event, the airport would suspend operations before water levels topped operational surfaces due to the likelihood that personnel living in the area would not be able to access the airport. This study assumes that many individual trips via air will be cancelled or postponed once the airport is closed. These cancellations are identified based on trip type and destination assessments.
- Reroutes – For the remaining individual air trips, this study assumes passengers will drive to the nearest airport that has their corresponding destination flight available.
- Calculations – Once the airport is closed and the remaining trip demand is calculated, remaining trips are treated as regional transportation trips.

Air Freight

Hector International Airport is not an active air freight hub. The vast majority of air freight to and from the region has its origin or destination in Sioux City, IA, or Grand Forks, ND. The impact of flooding on air freight is assumed to be marginal and is not further explored in this study.

1.4 Transportation Findings

The transportation impacts of the March 2009 flood and flood fight on the Fargo-Moorhead area were significant. During the flood fight, roadways along the Red River were submerged or used as footings for temporary levees, central corridors were repurposed as sand bag distribution routes, and roads were congested with emergency vehicles. The impacts of a failed flood fight would have a much broader and more severe impact. Disruption would extend across transportation modes and include the interstate system.

Table 1.7 presents the aggregated impact for each mode based on flood severity/probability. A duration was calculated for each corridor for the given flood event probability. Local Traffic disruption costs are estimated to jump drastically for a 50-year event due to the flood-fight activities. Local reroutes will increase as flooding severity increases (100-year to 500-year) due to expanding flood coverage and prolonged closure duration (related in part to lower priority roads remaining closed longer while higher priority roads are restored). Air and Rail Traffic are unaffected until a 100-year event (and the assumption of a failed flood fight). Once offline, the impacts to Air Traffic are limited by the assumption that a large percentage of trips will be canceled or rescheduled. The degree of damage to Rail Freight, once it is disrupted, is held constant as the severity of flooding increases (from 100-year to 500-year). This assumption is based on the longer-term necessity of planning the cross-country diversion and the high elevation of the tracks along the river. The impacts would drastically increase if the rail bed were damaged during flooding.

Table 1-7: Aggregated Monetary Impact by Mode for Each Identified Probability¹³ (Dollar amount rounded to the nearest 1,000)

Chance Event	Probable Occurrence	Automobile				Air Traffic		Rail Freight		Total
		Local Traffic Duration*	Local Traffic Impact	Regional Truck and Traffic Duration	Regional Truck and Traffic Impact	Air Traffic Duration	Air Traffic Impact	Rail Freight Duration	Rail Freight Impact	
50% (2-year)	0.5	0	\$ -	0	\$ -	0	\$ -	0	\$ -	\$ -
20% (5-year)	0.2	0	\$ -	0	\$ -	0	\$ -	0	\$ -	\$ -
10% (10-year)	0.1	0-18	\$ 1,125,000	0	\$ -	0	\$ -	0	\$ -	\$ 1,125,000
5% (20-year)	0.05	0-24	\$ 1,442,000	0	\$ -	0	\$ -	0	\$ -	\$ 1,442,000
2% (50-year)	0.02	3-47	\$ 3,884,000	0.5	\$ 50,000	0	\$ -	0	\$ -	\$ 3,934,000
1% (100-year)	0.01	3.5-47	\$ 22,668,000	1.5	\$ 2,775,000	2	\$ 401,000	5	\$ 57,114,000	\$ 82,958,000
0.5% (200-Year)	0.005	4-47	\$ 24,546,000	2	\$ 3,700,000	3	\$ 602,000	5	\$ 57,114,000	\$ 85,962,000
0.2% (500-year)	0.002	4.5-47	\$ 27,734,000	2.5	\$ 4,625,000	4	\$ 802,000	5	\$ 57,114,000	\$ 90,275,000
0%	0.000	4.5-47	\$ 27,734,000	2.5	\$ 4,625,000	4	\$ 802,000	5	\$ 57,114,000	\$ 90,275,000

*Range represents the low and high of local closers during each event probability. Local road closer durations are based on closers during the 2009 flood fight event, USACE inundation estimates, and estimates of time required for debris clearance and roadway repair. Secondary local roads are assumed to remain closed longer in events where Interstates are also interrupted, because interstates will receive resource priority.

¹³ Study assumes flood-fight failure between the 50-year and 100-year event probabilities.

In Table 1.8, Estimated Damage totals from Table 1.7 are multiplied by the probability of the occurrence of each severity event. The results are added together to produce an estimated Average Annual Flood Damage.

Table 1-8: Average Annual Damage of Transportation Impacts for the Fargo-Moorhead Area without Project Conditions (Dollar amount rounded to the nearest 1,000)

Chance Event	Probable Occurrence	Incremental Probability	Estimated Damage	Average Damages	Annual Flood Damages
50% (2-year)	0.5		\$ -		
		0.3		\$ -	\$ -
20% (5-year)	0.2		\$ -		
		0.1		\$ 563,000	\$ 56,000
10% (10-year)	0.1		\$ 1,125,000		
		0.05		\$ 1,284,000	\$ 64,000
5% (20-year)	0.05		\$ 1,442,000		
		0.03		\$ 2,683,000	\$ 81,000
2% (50-year)	0.02		\$ 3,925,000		
		0.01		\$ 43,427,000	\$ 434,000
1% (100-year)	0.01		\$ 82,929,000		
		0.005		\$ 84,426,000	\$ 422,000
0.5% (200-Year)	0.005		\$ 85,923,000		
		0.003		\$ 88,075,000	\$ 264,000
0.2% (500-year)	0.002		\$ 90,227,000		
		0.002		\$ 90,227,000	\$ 181,000
0%	0.000		\$ 90,227,000		
Total Average Annual Flood Damages					\$ 1,503,000

The estimated Average Annual Flood Damage is \$1,503,000. Flood diversion alternatives proposed by the St. Paul District would effectively negate flood related transportation impacts within the area. Therefore, the average annual direct transportation benefit of the proposed diversions is \$1,503,000.

Transportation Impact Excluding Trip Cancellation

Due to the inherent uncertainty of estimating trip cancellation in a flood event a second analysis explored transportation disruption and delay excluding all trip cancellation assumptions. Tables 1-9 and 1-10 represent the monetary impact of flooding on transportation assuming no trip cancellation during a flood event.

**Table 1-9: Aggregated Monetary Impact by Mode for Each Identified Probability
(Assuming No Trip Cancellation)**

Chance Event	Probable Occurrence	Automobile		Air	Rail	Total
		Local Traffic	Regional Truck and Traffic	Air Traffic	Freight	
50% (2-year)	0.5	\$ -	\$ -	\$ -	\$ -	\$ -
20% (5-year)	0.2	\$ -	\$ -	\$ -	\$ -	\$ -
10% (10-year)	0.1	\$ 8,439,000	\$ -	\$ -	\$ -	\$ 8,439,000
5% (20-year)	0.05	\$ 10,526,000	\$ -	\$ -	\$ -	\$ 10,526,000
2% (50-year)	0.02	\$ 20,420,000	\$ 129,000	\$ -	\$ -	\$ 20,550,000
1% (100-year)	0.01	\$ 228,306,000	\$ 3,647,000	\$ 937,000	\$ 57,114,000	\$ 290,005,000
0.5% (200-Year)	0.005	\$ 255,585,000	\$ 4,863,000	\$ 1,406,000	\$ 57,114,000	\$ 318,968,000
0.2% (500-year)	0.002	\$ 277,736,000	\$ 6,079,000	\$ 1,874,000	\$ 57,114,000	\$ 342,804,000
0%	0.000	\$ 277,736,000	\$ 6,079,000	\$ 1,874,000	\$ 57,114,000	\$ 342,804,000

Table 1-10: Average Annual Damage of Transportation Impacts for the Fargo-Moorhead Area without Project Conditions (Assuming No Trip Cancellation)

Chance Event	Probable Occurrence	Incremental Probability	Estimated Damage	Average Damages	Annual Flood Damages
50% (2-year)	0.5		\$ -		
		0.3		\$ -	\$ -
20% (5-year)	0.2		\$ -		
		0.1		\$ 4,220,000	\$ 422,000
10% (10-year)	0.1		\$ 8,439,000		
		0.05		\$ 94,830,000	\$ 474,000
5% (20-year)	0.05		\$ 10,526,000		
		0.03		\$ 15,538,000	\$ 466,000
2% (50-year)	0.02		\$ 20,550,000		
		0.01		\$ 155,277,000	\$ 1,553,000
1% (100-year)	0.01		\$ 290,005,000		
		0.005		\$ 304,487,000	\$ 1,522,000
0.5% (200-Year)	0.005		\$ 318,968,000		
		0.003		\$ 330,886,000	\$ 993,000
0.2% (500-year)	0.002		\$ 342,804,000		
		0.002		\$ 342,804,000	\$ 686,000
0%	0.000		\$ 342,804,000		
Total Average Annual Flood Damages					\$ 6,116,000

Exclusion of trip cancellation assumptions provides a much larger Average Annual Flood Damages of \$6,116,000.

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